Australia's Electronics Magazine

SILICON CHIP

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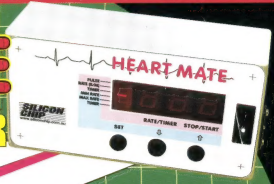
PROJECTS TO BUILD - SERVICING - COMPUTERS - VINTAGE RADIO - AUTO ELECTRONICS

HEARTMATE

HEART RATE MONITOR TO BUILD



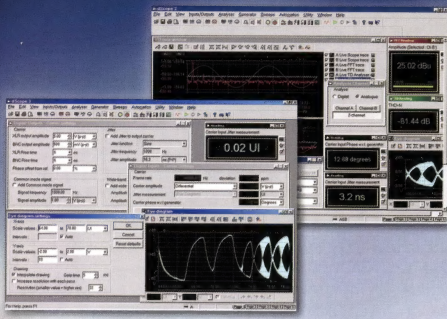
"Do Not Disturb"
AUTOMATIC 'PHONE HANGUPERER

PIC-TOC
The World's Simplest Clock

FEATURE: DIGITAL HIFI AMPLIFIERS

AND EVEN MORE PROJECTS INSIDE!

AUDIO TESTING JUST GOT A LOT EASIER



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Penguin's off!

Unfortunately, lack of space has forced us to hold over the third article on "Using Linux As An Internet Gateway". It'll be there next month – we promise!

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PUBLISHER'S LETTER

The Electric Wiring Debate – have YOU sent in your "Statement of Will"!?

The electrical wiring debate goes on. But while most people agree with the campaign, the number who have responded positively by sending in their signed "Statement of Will" or copy of their "MY WILL" letter to their parliamentarians has been pretty underwhelming. Have YOU sent yours in? In effect, we have plenty of "Noddies" but most seem unable to pick up a pen.

I suppose this fits in with the general picture of Australians being apathetic but this is an issue which affects us all – all people who want to be able to work on electrical equipment. The campaign is really two-pronged. We're not just campaigning that people should be allowed to do their own home-wiring. There also should be no restrictions on people working on mains-powered equipment.

Let's get right down to the grass roots. For example, this issue also involves anyone who wants to work on vintage radios – they are mains-powered aren't they! Not only in Queensland, but now in most other states, you can't legally work on your own vintage radios. Happy with that? And amateur operators? Sorry, you can't touch a mains-powered transceiver.

In fact, we're talking about anyone who wants to assemble or service mains-powered equipment, whether it is a DIY project described in SILICON CHIP, servicemen working on TVs, VCRs, microwave ovens, photocopiers and printers, PCs and their monitors, and so on. ***Yes, if you're a tech, this law stops YOU earning a living!***

It also embraces people working in the broadcast industry working on studio equipment and transmitters, technicians servicing medical equipment in hospitals and doctors' surgeries and so on. ***Even if you have a PhD in electrical engineering, your career is over.***

Presently in Queensland, all these people are working illegally if they connect or disconnect non-live mains-voltage wiring and do not at least have a restricted licence. And even if they have a restricted licence, they can not legally construct or modify mains-voltage sections of any electronic equipment, nor troubleshoot such sections when they are live.

That such a situation could exist and spread to other states is utterly ludicrous.

Now don't be apathetic. You will be stopped from doing what you presently do now, which is to work on all forms of mains-powered equipment. Maybe you don't care if you are never legally allowed to do your own home wiring. But you WILL CARE if you are eventually stopped from building a kit because it's got a mains powered transformer and/or other mains-voltage circuitry.

This is the situation in Queensland RIGHT NOW. If we don't do anything, it WILL become the same right across Australia.

Actually, if you take the present law in Queensland, it probably means that no-one can even open up their own computer to change a card or insert more memory. After all, most PCs are mains-powered.

Furthermore, as outlined elsewhere in this issue, no electrical or electronics engineer, no matter how highly qualified or experienced, can ever get a licence to do wiring. If he lives in NSW, and if he is a power, protection or control engineer, he has a slight chance of being able to get one, but only after he has

been approved so he can do the prescribed TAFE course.

So we have the situation where engineers can design large and complex electrical installations but they can never touch the wiring. They can't even work on the ordinary domestic fixed wiring system in their own homes!

Now come on – let's get REAL.

As part of getting REAL, let us acknowledge that at the very least, home-owners should be legally able to replace defective light switches and power points and install light fittings. They should also be able to temporarily unscrew light switches and power points from walls and tape them up, so that they won't be painted over during re-decorating. After all, that is what a lot of people do now and surely no one can argue that this is a significant source of fatalities – it clearly isn't.

But we are going even further. We are campaigning so that home-owners can legally do any domestic wiring right up to the switch-board, just as they do in New Zealand and most other western countries. In fact, in New Zealand home-owners can design and construct their own switchboard. They can also bolt it up and connect the house wiring to it under the supervision of an electrician!

Concurrently, we are campaigning to have all the silly restrictions on people working on all mains-powered equipment removed.

OK, so how have electricians reacted to this campaign? On the whole, they have been utterly negative. **They generally refuse to accept the fact that most western countries: (a) permit home-owners to do mains wiring and appliance repairs; and (b) have a better safety record than Australia's.** While denying these facts they go on to claim that conditions in Australia are somehow more dangerous than elsewhere.

On this last claim, the electricians MAY have a point! Not that our 240VAC electrical system is inherently any more dangerous than in most other countries. That is patently untrue. Some electricians have even tried to convince me that because we have so many migrants in this country, the situation is more dangerous because migrants don't know or care about regulations and safety and just wire things up willy-nilly. Well, that is nonsense. Migrants are no more careless and/or lacking in the relevant knowledge about wiring standards than other Australians.

No, the reasons why the situation in Australia may be more dangerous are twofold. First, inspections of domestic wiring by the electrical authorities are now practically non-existent or cursory at best. Electricians generally feel that this is wrong and that it lets the "cowboys" get away with bad and unsafe practices. That's fair comment. Of course, as far as letting home-owners do their own wiring, we are advocating that thorough inspection be mandatory for new installations and extensions. We have done that from the outset.

Second, there is no information available to the public on how domestic electrical wiring should be done. You can go into a hardware store and buy the cable, the conduit, the junction boxes and other fittings but nowhere does it tell you what cable should be used, how it should be wired and so on. This is a "chicken and egg" situation.

Because it is illegal, no information on how to do domestic wiring is available. Well, as soon as it becomes legal, the information on how to do it will become available.

In countries where it is legal for home-owners to do their own wiring, information on how to do it is freely available. For instance, the New Zealand government sells "code of practice" booklets to home-owners there (NZ$5 each), to provide guidance on various aspects of electrical wiring and appliance repairs. So while ever it is illegal in Australia for home-owners to do their own domestic wiring, the information on how to do it is likely to be unavailable.

Unless we change that, we will always have the potentially dangerous situation whereby home-owners CAN LEGALLY BUY all the electrical cable and fittings they want but never be properly informed on how it should be used.

Properly informing the public ensures that wiring done by home-owners will become safer. Add in the requirement for inspections, as in New Zealand, and the overall safety of wiring in homes must become much safer than it is now. After all, hundreds of thousands of Australians have illegally done their own "electrical work", and they will continue to illegally do it if the system does not change. So let's replace the electrician instigated official "voodoo" with some REAL PUBLIC KNOWLEDGE and just make the domestic electrical environment much safer, as most other western countries have done!

Electricians can't have it all their own way. If they are really concerned about safety, then they should be in favour of the changes we advocate. That way everyone would be much better informed about how safe wiring must be done.

Actually, we don't think that electricians are all that concerned about safety. If they were, the electricians who control the state Licensing Boards, Electrical Safety Offices, etc, would do something about the trip current for domestic safety switches in Australia. Overseas research shows that child fatalities occur at currents as low as 8mA (see "Personnel Protection Devices for Specific Applications" by the Electric Power Research Institute, EPRI, Pleasant Hill, CA, USA).

New Zealand research indicates that current as low as 5mA kills very young children. In the USA, domestic safety switches have a mandatory trip current of no higher than 10mA. In Australia, the trip current for domestic safety switches is 30mA. 10mA trip current safety switches are available in Australia

Continued overleaf ...

but are not mandatory. The electricians have clearly been napping!

By the way, what about this proposition: all homes should require an electrical wiring safety inspection when they are sold. That way, any dodgy wiring in older homes could be detected and fixed. After all, any home that is more than 40 years old probably needs a complete rewire anyway.

Why wait for injury or fatality to expose a wiring problem?

To summarise the campaign, we are appealing to the parliamentarians in each state to direct their electrical licensing authority to:

(a) remove any restrictions which may prevent people from working on mains-powered equipment, whether it is for the purpose of service and repair, restoration or assembly;

(b) produce legislation which is based on the New Zealand Electricity Act and Regulations, which allows householders to do their own "electrical work", including appliance repairs and the installation of fixed wiring.

You can do your bit to help by signing the "Statement of Will" in this issue and sending it to us. **PLEASE DO IT NOW!**

Leo Simpson

And now it's all up to YOU!

Send the completed forms to SILICON CHIP and we will forward them to the relevant state Ministers, along with copies of published correspondence, editorials, etc. The Ministers will be informed that their response, or a report that they apparently decided not to respond, will be published in SILICON CHIP!

While in some ways similar to a petition, it must be our aim that it is not treated as a petition. If you have access to the Internet, go to http://www.rag.org.au/rag/petqld.htm and study the onerous requirements that must, by law, be observed in order to produce a petition that a state parliament will accept. Then click on Creative Petitioning at the bottom of the page to learn how easily parliaments can disregard petitions.

Our state parliaments have refused to accept petitions that had many tens of thousands of signatures on them, simply because the form of the petition was not exactly correct. If you don't have access to the Internet, suffice to say that conventional petitions to our state and federal parliaments are largely a waste of time.

In addition to circulating the "Statement of Will" form, write an individual "MY WILL" letter, similar to the one below, to your local state member of parliament and encourage others to do the same.

Don't forget to date the letter and provide your name and address so the parliamentarian can confirm that you are a constituent.

Dear Sir (or Dear Madam),

I know that it is my duty to keep you informed of MY WILL on any matter that comes before Parliament, or that should come before Parliament.

IT IS MY WILL that you take immediate action to end the "closed shop" that electricians enjoy in relation to "electrical work", and that you promote the replacement of current electricity related legislation with legislation that is essentially equivalent to the New Zealand Electricity Act and Regulation, which allows householders to do their own "electrical work", including appliance repairs and the installation of fixed wiring.

Yours Faithfully,

(signed)

Above all, don't enter into written argument with a politician. Politicians are masters in the art of avoiding what they don't want to face up to, and become experts in manipulating words to their own benefit.

Should your parliamentary member try to sidestep (and they are extremely adept at doing so) taking positive political action on your behalf (ie, they rattle on about what his/her party is or is not doing instead of agreeing to act in accordance with your WILL), you simply write back and state:

Dear Sir (or Dear Madam),

*Further to my letter of (insert date of your original letter) and your reply of (insert date of their inadequate or fob-off reply), and in accordance with my lawful obligation to keep you informed of MY WILL, I **again** inform you that IT IS MY WILL that you take immediate action to end the "closed shop" that electricians enjoy in relation to "electrical work", and that you promote the replacement of current electricity related legislation with legislation that is essentially equivalent to the New Zealand Electricity Act and Regulation, which allows householders to do their own "electrical work", including appliance repairs and the installation of fixed wiring.*

Yours faithfully,

(signed)

If you have access to the internet, go to http://www.rag.org.au/rag/mywillet.htm and learn about the background and potential power of the "MY WILL" letter. For each "MY WILL" letter you send to your parliamentary member, send a copy to SILICON CHIP so we can monitor the level of involvement in the campaign for reform.

If your local parliamentarian shows interest in the issue, provide them with copies of relevant SILICON CHIP published correspondence and editorials, etc, or ask them to contact SILICON CHIP directly.

Come on SILICON CHIP readers, you asked us to help you with this one – if you don't want more and more restrictions, get those signatures rolling in!

This information (including a copy of the "MY WILL" form) may also be downloaded from the SILICON CHIP website, www.siliconchip.com.au

Statement of Will: Reform of Electrical Legislation

The primary responsibility of parliamentary representatives and governments is to do ***the will of the people****. Electors must make* ***their will*** *known to their parliamentary representatives and governments.*

We, the undersigned, hereby assert ***that it is our will*** *that the government of *_____ acknowledge that current electrical safety legislation unjustifiably discriminates against ordinary householders as well as electrical and electronic engineers, technical officers, and technicians and that the effect of its enactment has been, and continues to be, to protect a monopoly for licensed electricians.*

We also hereby assert ***that it is our will*** *that the government of *_____ acknowledge that the potential dangers of "electrical work" are grossly exaggerated by the state electrical licensing boards and that the New Zealand electrical fatalities and accidents statistics belie these claims of dangers.*

We further assert ***that it is our will*** *that the government of *_____ repeal, in a timely manner, all current electrical safety legislation to replace it with legislation that is essentially equivalent to the New Zealand Electricity Act and Regulation, which allows ordinary householders to do their own "electrical work", including appliance repairs and the installation of fixed wiring.* ** (insert state or territory)*

	Name	Address	Signature
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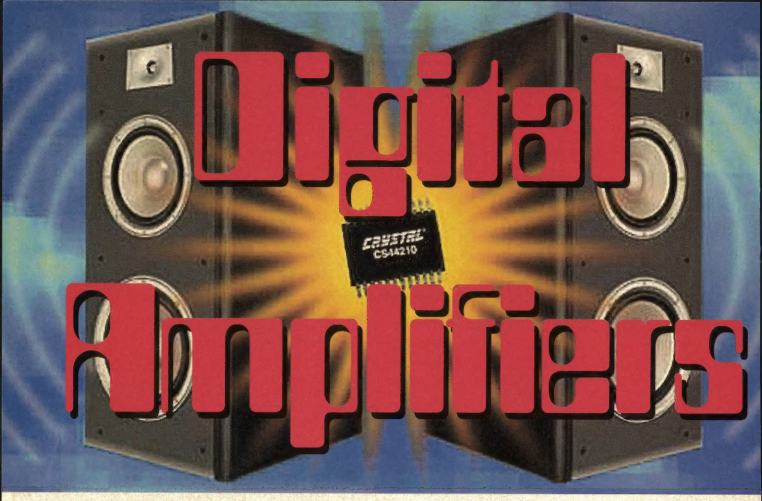


Digital Amplifiers are here!

Analog Audio could soon be dead!

Audio recordings have been revolutionised by digital technology, which has allowed dramatic improvements in signal-to-noise ratio, distortion, wow/flutter and frequency response. Now the same kind of revolution is well under way in an area which many of us probably still see as the exclusive domain of analog circuitry: audio power amplifiers.

By JIM ROWE

When **Compact Discs** burst onto the audio scene in the early 1980s, they quickly changed the definition of 'hifi'.

Suddenly we had a recording and playback technology which could deliver a signal-to-noise ratio of 96dB, distortion levels below 0.01%, negligible wow and flutter and a frequency response which was near enough to 'ruler flat' over the complete audible spectrum.

CDs delivered these benefits mainly because they took advantage of digital technology. Instead of trying to record audio waveforms faithfully in the grooves cut into vinyl records, they 'sampled' the waveform 44,100 times per second and turned it into a stream of binary numbers – ones and zeros – which could be recorded and played back much more faithfully. This made it possible to reconstruct a much more accurate replica of the original, when the digital samples were converted back into analog form.

The same sort of benefits came when digital technology was applied to tape recording to provide us with DAT (digital audio tape). And the improvements continue, with the new enhanced digital recording techniques such as HDCD (High Definition CD), SACD (Super Audio CD) and DVD-Audio – which are just coming onto the market.

But until very recently, the high quality audio available from these digital technologies still had to be converted back into analog for the last crucial step in the audio chain: power amplification to drive the speakers. That's because up till now, analog circuitry has provided the only way to achieve a high-quality audio power amplifier.

Sony's Playstation 2, announced and released with such fanfare a few months back, contains a digital audio amplifier courtesy of Tripath. Sony's new VAIO (Video Audio Integrated Operation) notebook computers also contain a similar digital audio amplifier.

Even today, some audiophiles will tell you that the only kind of power amplifier worth listening to is one with a class A (or at worst, class AB) push-pull output stage, with a whopping great power supply, plenty of heatsinking and loads of negative feedback.

And there's the rub: traditional high quality analog power amps and their power supplies are big, heavy, expensive and wasteful of power.

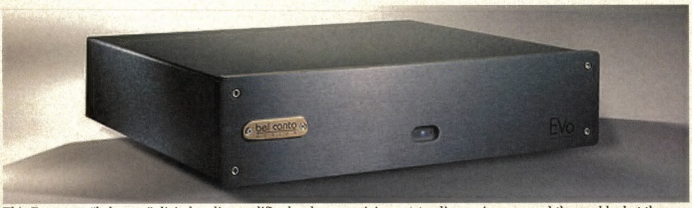
These disadvantages have been becoming more and more of a problem as manufacturers were pushed to make their products smaller, lighter, more efficient and of course, cheaper. Many products do need to incorporate audio power amps – and in some cases more of them than ever before, like home theatre systems and computer sound systems.

So there's been a huge amount of R&D effort invested in digital technology to achieve the kind of improvements with audio amps that it's already provided in areas like recording and playback.

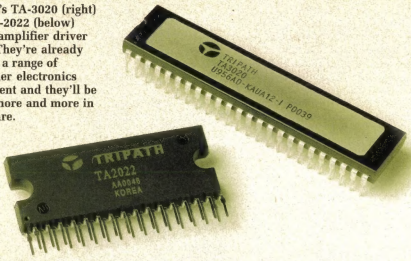
Lofi digital

The first digital amplifiers to come out of this R&D were pretty terrible and anything but 'hifi'. Sure they were efficient but the signal-to-noise ratio was poor and most of them radiated so much switching noise that you couldn't even bring a distortion meter near them, let alone measure their distortion level!

In the last couple of years, though, that R&D has really begun to bear fruit. Many of the latest stereo TVs and home theatre systems from firms like Sony, Sharp and Hitachi now have true dig-



This Evo 200-2 "bel canto" digital audio amplifier has been receiving outstanding reviews around the world – but then with its $US2395 price tag it would want to! Specs are 1Hz-80kHz, 240W RMS per channel. Unfortunately, though, one reviewer was a little over the top in saying it was at least as good as the best tube (valve) amplifier he had ever heard. . .



Tripath's TA-3020 (right) and TA-2022 (below) digital amplifier driver chips. They're already used in a range of consumer electronics equipment and they'll be found more and more in the future.

ital audio amps, as does Sony's new Playstation 2 and its VAIO handheld computers. Apple Computer's latest Power Mac G4 computers also use them, as do Altec Lansing's latest PC speaker systems.

Car audio firms like Alpine and Blaupunkt are using them in their latest models, and some of the new personal audio players and mobile phones are said to use them as well.

Manufacturers like Sharp have even released true audiophile-level digital amplifiers, with specs that more than compare with the best traditional analog designs.

The end of analog?

In short, the writing is on the wall: the future of high quality audio amplifiers is eventually going to be digital, probably much sooner than most of us expected.

Is this just because designers have found ways to get acceptable performance out of digital amplifiers or because they can get away with smaller heatsinks and power supplies?

No, although those factors obviously help, it's because digital amplifiers actually make more sense, now that so much audio material is being recorded and transmitted in digital form.

With digital amplifiers the audio can be kept in this form right up to the high power level, ready to drive the speakers – which not only makes the whole system more efficient but provides the potential for even higher quality of reproduction (because there's less signal processing).

For example, audio is stored on the HD layer of the new SACDs in 'Direct Stream Digital' form, which is already suitable for passing directly through many of the new digital amps. In fact, this is the best way of achieving the full enhanced audio performance from SACDs, rather than converting the signal back into analog form and feeding it through a traditional analog amp.

The same applies to normal CDs and the new DVD-Audio discs, even though their LPCM (linear pulse-code modulation) audio has to be passed through additional upsampling and other digital processing circuitry.

Even compressed multichannel digital audio like Dolby Digital, MPEG2 and DTS bitstreams can give better results, as the decoding and other processing can again all be done in the digital domain where they introduce far less noise and distortion.

So there are compelling reasons for digital amplifiers. In a couple of years, just about all new consumer equipment is likely to have digital amps.

Probably diehard audiophiles will keep using traditional analog amps (hey, some are even still using valve analog amps!) but eventually....

By now you're probably wondering how designers have been able to come up with digital amps which achieve true hifi performance, as well as very high efficiency. Let's see how they've done it.

How they work

Digital amplifiers don't handle multi-bit LPCM digital audio – the kind of 16-bit samples that come from a CD or the higher resolution 24-bit samples from DVD-Audio. Not directly, anyway. They handle a 'bitstream' or single-bit digital signal.

Single-bit signals have been used in recent years to make many of the highest quality digital master recordings. Well known examples are Philips' Bitstream, Matsushita's MASH and Sony's Super Bit Mapping (SBM).

Another general name for this format is Sigma-Delta Modulation (SDM), and it's used for making master recordings because it's actually capable of much higher fidelity than LPCM. The resolution can be equivalent to 24 bits or better, with a frequency response of DC to 100kHz and a dynamic range of over 120dB, as a result of noise-shaping techniques.

To produce normal CDs, master recordings made using SDM are converted into PCM by digital processes known as decimation and brick-wall filtering. This inevitably causes some degradation, which is why Philips and Sony decided that to ensure higher fidelity on SACDs they would directly record the SDM bitstream – renamed Direct Stream Digital.

Part of the reason why SDM can deliver much higher fidelity is that it's a lot simpler to convert analog audio into SDM, than in a conventional multi-bit analog-to-digital converter. This is done by a Sigma-Delta modulator. As you can see from Fig.1,

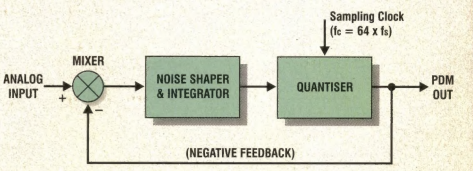


Fig.1: A basic sigma-delta modulator, which converts analog audio into a PDM digital bitstream. They've been used for years as A/D converters for making digital master recordings.

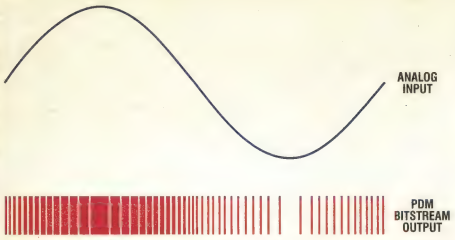


Fig.2: How the pulse density in a PDM bitstream corresponds to the amplitude of the original analog signal.

this consists of an analog mixer, a noise-shaping filter/integrator and a quan-tiser.

Think of the quantiser as essentially a comparator which is gated by a high frequency clock signal, and driving a storage flipflop. Typically the clock frequency is 2.8224MHz, or 64 times the 44.1kHz sampling rate used for CDs.

Because of the negative feedback loop, the integrator's output represents the difference between the input voltage and the digitised output from the previous sample, accumulated over the 354ns sampling period. So the quantiser's next output will be a 1 if this accumulated difference is positive (ie, the input voltage rose slightly), or a 0 if it's negative.

The output from the modulator is therefore a single pulse train of bits at the 2.8224MHz clock rate, with their density representing the instantaneous amplitude of the original audio waveform. This is shown in Fig.2. Another name for this kind of A/D conversion is pulse density modulation or PDM.

As well as being a very simple and direct method of A/D conversion, sigma-delta modulation has much higher inherent linearity than a multi-bit A/D converter. As a result of the very high sampling rate it also doesn't need sharp-cutoff 'brickwall' filters to prevent aliasing.

And although the basic modulator shown in Fig.1 does tend to have a poor signal-to-noise ratio, it turns out that this can be dramatically improved by using 'higher order' noise shaping circuitry. This involves additional feedback and integrators, with the effect of shifting most of the noise up and out of the audio range. The signal-to-noise ratio in the audio range (even up to 100kHz) can thus be improved to 120dB or so.

Finally, a PDM bitstream has another huge advantage over multi-bit LPCM: it's much easier to perform digital-to-analog (D/A) conversion. In fact, with PDM you don't need a complicated D/A converter at all, just a simple low-pass filter after the power amp's output switching, as shown in Fig.3.

In fact, Fig.3 is so simple that you can see why digital amplifiers are going to take over. PDM makes everything a lot easier – it's still a true digital signal but one that's very easy to convert back into analog.

Virtually all the new digital amps handle the digital audio as this kind of single-bit stream, so apart from the DSD audio from SACDs, all other kinds of digital audio have to be converted into this form by over-sampling and other digital processing.

Similarly, any analog audio signals must first be converted into PDM using sigma-delta modulators, before they can be amplified (see Fig.4).

So this is the basic way digital amps work. But, as you might expect, the various manufacturers have made their own modifications to enhance the performance. Let's look a little more into the technology of practical digital amplifier chips.

Tripath's DPP

One of the leading players in producing 'hifi' digital amplifier chips is Tripath Technology, a fairly small firm in Santa Clara (California) founded in 1995 by semiconductor industry veteran Dr Adya Tripathi.

Tripath chips are being used in Sony's DAV-S300 compact home theatre system, in the Playstation 2 video game box and VAIO computers, and also in Sony's new plasma screen TVs.

Apple Computer is using Tripath digital amp chips in its latest Power Mac G4 computers, as is Hitachi in its own new 81cm plasma screen TVs. Marantz and Carver are apparently using Tripath chips in some of their latest hifi amps, while they're also being used in car audio systems from firms like Alpine and Blaupunkt.

Tripath describes its digital amps as having a 'Class T' configuration, to distinguish them from early 'Class D' digital amps which used fairly basic pulse-width modulation (PWM) technology. They stress that a Class T amp is very different from a PWM amp, both because of its output configuration and because it pre-processes the incoming digital bitstream using their patented Digital Power Processing (DPP) technology.

They're rather coy about the exact

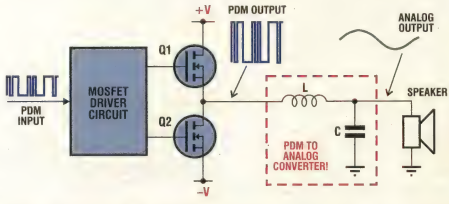


Fig.3: A major advantage of using PDM for digital amplification is that it can be converted back to analog simply by passing it through a simple low-pass filter.

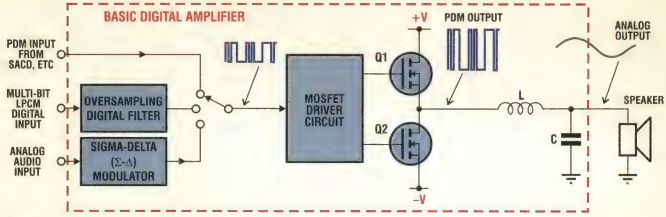


Fig.4: A very basic digital amplifier configuration. The amplifier can accept the PDM signal from a SACD player directly, but multi-bit digital audio and analog audio signals require some input processing.

details but it appears that their Class T power amp is actually a high power sigma-delta modulator stage with feedback right around the power switching stage and high-order noise shaping. The DPP block which drives it appears to use a technique of digitally modulating the basic DPM bitstream. Its clock signal frequency and exact timing are varied (from 200kHz up to 1.5MHz) with the sensed analog signal level, to pre-compensate for the switching limitations of the power Mosfets.

So the power amp switches at around 1.5MHz for low output levels but slides down to 200kHz for full analog output. It seems to be a bit like spread-spectrum technology but the end result is very linear and 'clean' analog output after the final low-pass filter.

Currently, Tripath makes three different integrated digital stereo amp chips, all with impressive specs. The lowest power TA1101B device is a 30-pin PSOP package measuring only 11 x 16 x 3.4mm but it gives 2 x 10W RMS into 4Ω loads at 0.04% THD+N (distortion and noise) running from 12V.

The efficiency is about 80%, so it needs only minimal heatsinking – an array of vias under the package, to conduct heat from its heat slug through to a copper pattern about 10 x 32mm on the other side of the PC board.

At the other end of the range is the TA2022, which is a 32-pin SSIP package and delivers 2 x 90W RMS into 4Ω loads at 0.1% THD+N, running from ±35V and with almost 85% efficiency.

For even higher power applications Tripath also make digital amp drivers, which provide everything for a complete Class-T stereo power amp apart from the power switching FETs. There are four of these amp drivers, one of which (the TA0104A) teams up with suitable power Mosfets to deliver up to 2 x 500W RMS into 4Ω loads (or 1000W in bridge-mode mono), at 0.05% THD+N and running at ±92V.

You can find more information about Tripath's digital amplifier devices at their website www.tripath.com

They have data sheets and application notes you can download as PDF files, along with white papers. Their patents are also available from the US Patent & Trademark Office website, at www.uspto.gov/patft/

Apogee's DDX

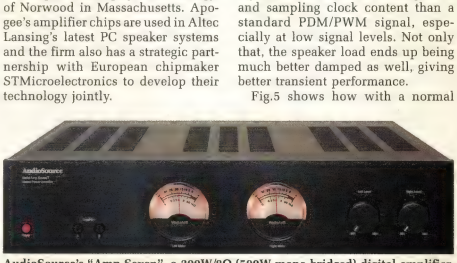
Another leading player in the digital amp field is Apogee Technology, of Norwood in Massachusetts. Apogee's amplifier chips are used in Altec Lansing's latest PC speaker systems and the firm also has a strategic partnership with European chipmaker STMicroelectronics to develop their technology jointly.

Apogee's chips are based on their patented Direct Digital Amplification or 'DDX' technology, which as the name suggests is designed to take a direct digital audio input and carry out all necessary processing and amplification in the digital domain.

A feature of DDX is that it carries out special processing to convert the incoming digital audio into a pair of modified PDM/PWM bitstreams. These are then used to drive the output switching Mosfets in a special way known as 'damped ternary', to give high efficiency and improved audio performance.

Instead of the two levels (1 and 0) in a normal binary waveform, the pair of digital signals produced by the DDX processor drive the Mosfets to produce a signal with three levels: +1, 0 and -1. (Hence the name ternary, meaning 'of three parts'.) This output signal has much less switching noise and sampling clock content than a standard PDM/PWM signal, especially at low signal levels. Not only that, the speaker load ends up being much better damped as well, giving better transient performance.

Fig.5 shows how with a normal



AudioSource's "Amp Seven", a 200W/8Ω (500W mono bridged) digital amplifier which uses Tripath's Class T technology. Distortion is less than 0.01% and it is stable into 2Ω loads. It accepts standard (ie analog) input signals but processes digitally. (www.audiosource.net).

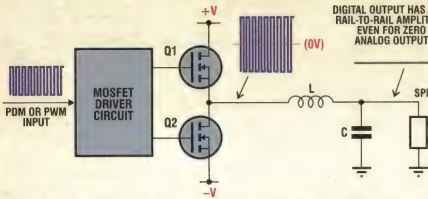


Fig.5: With standard PDM or PWM, the amplifier's digital output signal has a very high 'RF' content even for zero analog output. This calls for large filter components to get the electromagnetic interference down to acceptable levels.

PDM or PWM binary drive signal, a binary 1 switches on one output Mosfet (s3ay Q1) to apply the full positive supply voltage to the speaker (via the low pass filter), while a binary 0 level switches on the other Mosfet Q2 to apply the full negative supply voltage. These are the only two output levels available, but the amplifier switches back and forth between them at a very high rate to provide an average level which varies with the audio output waveform – after it's filtered, of course.

Note that for all audio signal levels between peak positive and peak negative, the output Mosfets have to be switched on in turn during each clock period (or in alternate clock periods, with PDM) in the time ratio necessary to give the right instantaneous average level for the audio waveform. So for zero output voltage, they must each be switched on for 50% of the time – giving a very low audio voltage after the output filter. However, at the same time there will be a very high level of sampling clock signal (and its harmonics) at the input to the filter.

DDX neatly avoids this problem when it converts the PDM signal into the drive signals for its ternary form. The processor works out the degree to which the two output levels would cancel each other at the output when they were averaged, and then it removes this part of the digital signal in advance. So only one or the other of the output Mosfets is turned on during that sampling period, for a proportion of time which gives the right average value.

Or if the audio waveform should have a value of zero at that instant, neither main Mosfet is turned on at all.

Fig.6 shows the idea, using an H-bridge output switching circuit.

As you can imagine, this reduces the level of clock signal 'RF' at the amplifier's output dramatically, and makes it possible to use significantly smaller values of L and C in the filter circuit.

In addition, though, the DDX power switching driver circuit itself pulls a neat trick. When neither of the ternary drive signals is at the 1 level, it turns on the two lower output Mosfets (ie, Q2 and Q4). So instead of getting any output energy, the speaker voice coil has a low resistance connected across it: the 'on' resistance of the two lower Mosfets (typically a fraction of an ohm) plus the DC resistance of the filter inductors.

This applies heavy damping to the voice coil, which improves its transient behaviour. (Editor's note: we don't quite believe all that but a simple damping test would show if it was true.)

The net result of the DDX technology is a digital amp which has very good signal-to-noise performance, low RF radiation and good speaker damping, while still offering very high electrical efficiency even at low signal levels.

Apogee offers a single DDX stereo power amplifier device, which can be driven by either of two DDX processor/controller chips. The DDX-2060 power amp is a 36-pin package measuring 16 x 11 x 3.6mm. It can deliver 2 x 35W RMS into 8Ω loads with less than 1% THD+N, running from 28V. Alternatively, it can deliver 70W in mono mode into a 4Ω load, again with less than 1% THD+N and running from 28V.

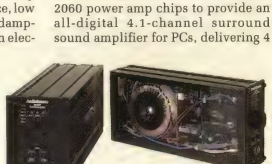
To make a complete digital stereo amplifier, a DDX-2060 is driven from the DDX-2000 controller chip. This is a 44-pin quad plastic flat package measuring only 10.5 x 9.5 x 2mm. It provides all of the processing to convert a serial multi-bit digital audio signal (from say an S/PDIF receiver) into a stereo pair of Apogee's ternary drive signals – to drive each channel of the 2060.

The DDX-2000 also provides a digital volume control function, managed by an external controller via an I^2C bus.

Apogee provides details of a complete 5.1-channel surround sound amplifier system which uses three DDX-2000 controller chips to drive four DDX-2060 power amp chips. With the controller chips running from 3.3V and the power chips from 28V, this configuration can take the serial digital signals from a Dolby Digital decoder chip and provide 4 x 35W for the FR, FL, SR and SL speakers, 35W for the FC (centre) speaker and 70W for the LFE subwoofer.

A single volume microcontroller can adjust both master volume and channel balancing.

The second of Apogee's DDX controller chips is the DDX-4100, which provides all of the processing to provide DDX drive signals for five separate DDX power amp channels (ie, 4.1 channels of surround sound audio), from two different types of digital input signal: either S/PDIF (Sony/Philips Digital Interface) stereo, or I^2S/AC'97 (a Microsoft development) four-channel inputs. This means that one DDX-4100 can drive three DDX-2060 power amp chips to provide an all-digital 4.1-channel surround sound amplifier for PCs, delivering 4



Another AudioSource model, the "Amp Six" modular dual-channel (stereo or bridged mono) digital amplifiers again using Tripath's Class-T technology.

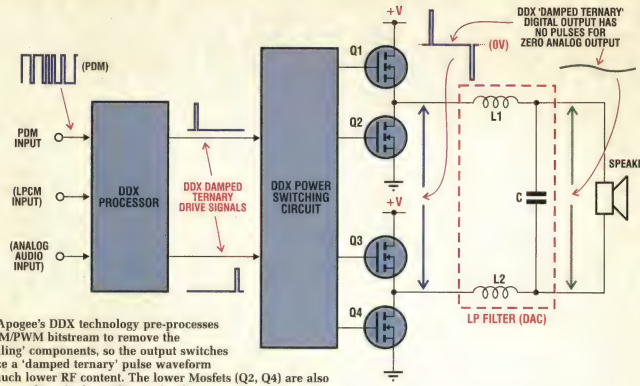


Fig.6: Apogee's DDX technology pre-processes the PDM/PWM bitstream to remove the 'cancelling' components, so the output switches produce a 'damped ternary' pulse waveform with much lower RF content. The lower Mosfets (Q2, Q4) are also turned on to heavily damp the speaker between the pulses, giving better transient performance.

x 35W plus 1 x 70W of high quality audio at over 85% efficiency.

The DDX-4100 also provides sample rate conversion, digital bass, treble and volume controls, bass management for the LFE channel and parametric equalisation for all five channels. All this comes in a 44-pin TQFP package measuring 10mm square!

Apogee's website at www.apogeeddx.com provides full data on their chips and a white paper on DDX technology.

Incidentally, you might be wondering what the difference is between "4.1 channel" surround sound and "5.1 channel" surround sound.

4.1 channel sound is basically what you get from matrix-type 'analog' surround decoders like Pro-Logic: front left and right, plus centre front (basically L+R) and a single surround channel (basically L-R), with the '0.1' channel carrying the bass from the centre front channel, LP filtered to run a subwoofer.

On the other hand 5.1 channel sound is usually that from a digital decoder, with discrete FR, FL and FC front channels, two surround channels (SR and SL), and a discrete 'low frequency effects' or LFE channel for the subwoofer.

The term ".1" is used to indicate the fact that the frequency response of that channel is deliberately limited to cover bass frequencies only; this channel is invariably used by the subwoofer.

Only the start...

Tripath and Apogee are not the ony firms working on all-digital amplifier chips. Cirrus Logic has just released a new Crystal 'TrueDigital' PWM amplifier controller chip, the CS44210, which is a complete digital stereo amplifier apart from the output switching Mosfets and their driver ICs.

It provides all processing for upsampling and sample-rate conversion from up to 24-bit digital inputs, digital volume, bass and treble controls, muting and de-emphasis, and even low power digital outputs to drive stereo headphones – all in a 24-pin TSSOP package measuring just 7.8 x 4.4 x 1.1mm.

Together with a set of driver chips and power Mosfets, the CS44210 forms a digital stereo amp with 2 x 50W output into 8Ω loads, with an output dynamic range of 100dB and an energy efficiency of 90%. You'll find full data on the Cirrus chip at www.cirrus.com

Texas Instruments has released a low-power PWM amplifier chip, the TPA2000D2 (2 x 2W RMS into 4Ω at 5V), with higher rated versions due shortly. Both Motorola and National Semiconductor have announced similar products, while Philips plans to have digital amp chips available later in the year.

Other firms are already active at the equipment level. Last year, for example, Sharp Corporation released its SM-SX100 single bit 2 x 100W stereo amp offering true audiophile quality with a breathtaking $25,000 price tag.

This year they're releasing two mini stereo systems using the same all-digital technology and outputs of 20W/channel and 25W/channel respectively, with price tags below $3000.

It's very likely that most of the main consumer audio manufacturers will announce digital amps and systems before long, so prices will soon plummet.

The digital amplifier era has definitely begun. Before the year is out you could be to be listening to one in your car, lounge room or computer room – or in your Walkman or mobile phone.

Welcome to the all-digital audio future! **SC**

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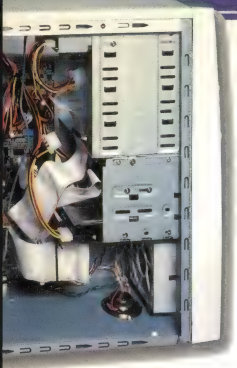
A PC TO DIE FOR

Part 2: installing the operating system & squashing the bugs

By GREG SWAIN

Last month, we showed you how to build a great PC based on a 1GHz Athlon CPU and an Asus A7V133 motherboard. This month, we're going to show you how to partition and format the hard drive and install Windows Me (WinMe) as the operating system.



INSTALLING THE OPERATING system on a new computer is usually quite straightforward – a piece of cake, in fact. If you haven't been through the process before, here's your chance to learn.

We're going to describe the installation of Windows Me but the procedure is pretty much the same for other operating systems. Basically, it involves a 5-step process:

(1) Tweak a few motherboard BIOS settings;

(2) Partition and format the hard disk drive;

(3) Install the operating system;

(4) Install specialised device drivers, as necessary (eg, for graphics and sound cards); and

(5) Connect to the Internet and download any critical updates for the operating system.

OK, we're about to turn the computer on for the first time but before doing so, it's a good idea to remove the sound card. Yes, we know that we instructed you to install this card last month but experience has shown that it's best to install the operating system first, then add the sound card later. The same applies to any other devices.

Now take a good look at the system and check that everything is correct. In particular, make sure that all the drive cables and power connectors are plugged in and that nothing can interfere with the CPU fan. If this stalls, you'll get a distinct burning money smell as the CPU "fries".

Switching on

Now for the smoke test – hook up the mains power leads and switch on. If everything is OK, the system will go though its Power-On Self Test (POST) routine. First, it should show the type of video card used (at the top of the screen), along with the amount of video RAM (32MB for the board specified). It should then correctly identify the motherboard BIOS version and the processor before going through the memory test procedure.

At this stage, you should press "DEL" to get into the BIOS Setup Utility. This will take you directly to the Main menu, as shown in Fig.1. What we're going to do now is change a few of the BIOS settings so that everything is identified and works correctly.

The BIOS Setup Utility is easy to navigate – just use the arrow keys to jump from one setting to the next (and from one Menu screen to the next) and press <Enter> to bring up a sub-menu when you want to change a setting. The -/+ keys are then used to change the setting, after which you hit the <Esc> key to take you back to the previous menu.

It's hardly the stuff of rocket science and you'll soon become adept at finding your way around, even if you've never ventured into a BIOS setup screen before.

Anyway back to the main chase. Begin by setting the system time and date to the correct values, then check that the floppy disk drive (ie, Legacy Diskette A) has been correctly identified.

This done, you have to "tell" the system what drives are hanging off the primary and secondary IDE ports. Now this bit is important – these two IDE ports have nothing to do with the two Ultra ATA100 IDE ports that are also on the motherboard. In fact, the Ultra ATA100 ports are not covered by the Award BIOS – instead, they have a separate BIOS chip on the motherboard and are detected later during the boot process.

In our machine, the only item to be covered here is the DVD-ROM drive which is connected as a master to the primary IDE port. As a result, we set the Primary Master drive type to "Auto" (for auto-detect) and this showed up as "ATAPI DVD-ROM 16X Maxim" after we hit the <Esc> key to take us back to the Main menu.

If you have any other drives hanging off the IDE ports, these can be set to "Auto" (for auto-detect) as well. Alternatively, you can choose the drive

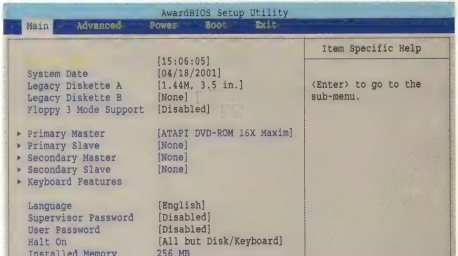


Fig.1: this is the main BIOS setup screen. You set the system time and date here and adjust the settings for the primary and secondary IDE ports. In our case, the DVD-ROM drive was on the "Primary Master" IDE port – see text.

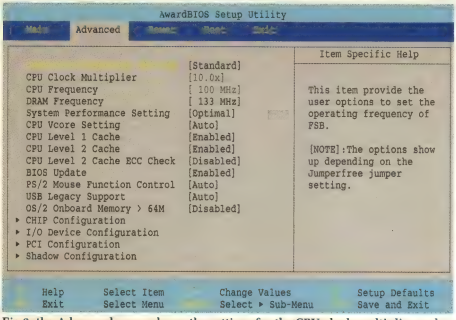


Fig.2: the Advanced menu shows the settings for the CPU clock multiplier and bus frequency. In this case, we are using a 1GHz processor and the settings are 10.0 and 100MHz respectively (10 x 100MHz = 1GHz). Because we are using PC133 SDRAM, the DRAM frequency has been bumped up to 133MHz.

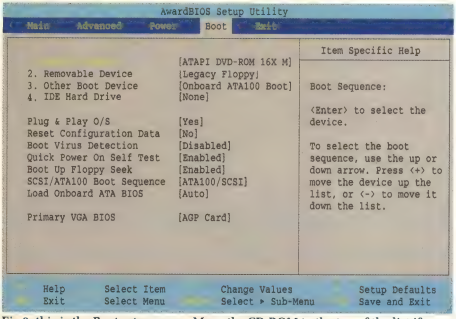


Fig.3: this is the Boot setup menu. Move the CD-ROM to the top of the list if you have an OEM or full retail version of the operating system. The floppy drive should come first if you are installing an upgrade version.

"type" if devices other than hard disk drives are involved; eg, CD-ROM, ZIP-100, etc.

What about the Quantum Fireball hard disk drive used in our machine? Well, that's connected to the primary Ultra ATA100 IDE port and is automatically detected during boot-up, so we don't have to enter any special settings.

Next, flick across to the Advanced menu (just press the left arrow key) and check the settings shown in Fig.2. Assuming that you configured the Asus motherboard in JumperFree mode as described last month, these settings should all be automatically identified and should be correct.

In particular, for a 1GHz CPU the "CPU Clock Multiplier" will be set to 10.0x, while the "CPU Frequency" will be 100MHz – ie, 10 x 100MHz = 1GHz. Actually, these two settings will be "greyed out", which means that you cannot change them – at least not when the "Operating Frequency Setting" is set to "Standard".

The "DRAM Frequency" setting defaults to 100MHz to ensure system stability. However, provided that you've used 133MHz SDRAM, you can bump this setting up to match (ie, to 133MHz) to squeeze a bit more performance.

Overclocking

For those interested in overclocking, changing the "Operating Frequency Setting" to "User Define" lets you tweak both the CPU clock multiplier and frequency settings. You can manually set the multiplier anywhere in the range from 5.0x to 12.5x, while the CPU frequency can be tweaked in 1MHz steps over the range from 100MHz to 166MHz (note: this was incorrectly stated as 133MHz last month). Bus frequency settings of 90MHz and 95MHz are also available.

Our advice here is simple – DON'T DO IT! If you want to play around with overclocking, at least wait until the operating system is installed and everything is working correctly. Even then, we don't recommend overclocking unless you know exactly what you are doing.

Actually, we think that the performance gains to be had from overclocking are so small as to not warrant the increased risk of system instability and CPU damage. The same goes for the "CPU Vcore Setting" – leave it on the default Auto setting unless you know what you are doing.

Most other settings here can be left on the defaults. You can refer to the motherboard manual for more information on these.

Boot sequence

OK, now let's flick across to the Boot menu and sort out the boot sequence (Fig.3). This determines which drive the system boots from and your choice will depend on whether you're installing a full retail version or an upgrade version of the operating system.

If you have a full retail (or an OEM) version, you can boot directly off the CD-ROM. The system will then pretty much automatically partition and format the hard disk for you, prior to installing the operating system.

Conversely, if you are installing an upgrade version, you have to boot from

a Windows Me (or Windows 98) startup floppy. You then have to manually partition and format the hard drive yourself. After that, you need to reboot from the startup floppy to load the necessary drivers for the CD-ROM drive, so that the operating system can be installed.

It all boils down to this – if you have a full retail or OEM version of the operating system, place the DVD-ROM drive at the top of the boot order. Alternatively, if you are using an upgrade version, place the floppy disk drive (Legacy Floppy) at the top.

While you're at this menu, set the Plug & Play O/S to "yes" (assuming you're using Windows 98/Me/2000) and disable the boot virus detection feature. The setup procedure is going to write to the boot sector of the drive when installing the operating system, so we don't want any false alarms here (you can re-enable the virus protection when setup is complete).

Once that's done, flick to the Exit menu, save your changes and exit from the BIOS Setup Utility.

Operating system versions

Before going further, let's clear up a misconception that many people have about "full" and "upgrade" versions of an operating system. An upgrade version is in no way "inferior" to a full version. The main difference between them is that you cannot boot from an upgrade CD-ROM and it doesn't include the partitioning and formatting tools included in the full version.

An upgrade version also performs a "compliance" check during installation, to confirm that you already have an earlier version of Windows. Naturally, if you are "clean installing" an upgrade version onto a new hard disk, there will be no evidence of the previous operating system. The way around this is to "show" the system the CD-ROM for the earlier version when prompted to do so during the compliance check routine (see panel), after which the installation will proceed normally.

Apart from that, an upgrade version is identical to a full version and installs exactly the same system onto the hard disk.

Partitioning and formatting

We'll assume here that you have an OEM or full retail version of Windows Me. Begin by inserting the WinMe CD-ROM in the drive, then restart the machine and choose "Boot from CD-ROM" and "Start Windows Me Setup from CD-ROM" from the resulting menus. The setup procedure will now automatically partition and format the disk drive.

Be sure to choose "enable large disk support" when prompted. This installs the FAT32 file system which is necessary for the operating system to recognise large disk partitions. By contrast, the older FAT16 file system limited partition sizes to 2.1GB and that's hardly enough these days. A FAT32 file system also reduces cluster size (down from 32KB to 4KB) and that means less disk wastage.

Installing Windows

After formatting, the system will automatically reboot and run Scandisk before going to the Windows Me Setup menu to install the operating system. This basically involves a 5-step process, as follows:

(1) Preparing to run Windows Setup;
(2) Collecting information about the computer;

Fixing Up The Video Driver

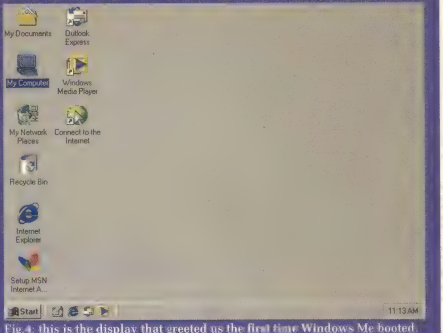


Fig.4: this is the display that greeted us the first time Windows Me booted. This occurred because WinMe installed a generic video driver running at 640 x 480 and 16 colours.

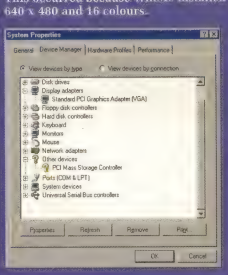
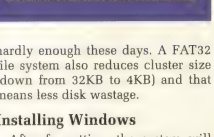


Fig.5 (left): the System Properties dialog box confirms the type of video card driver installed. It also shows a problem with the "PCI Mass Storage Controller".

Fig.6 (below): the new video driver is a snack to install – just auto-run the driver CD & click Install Driver.



The Gentle Art Of Hard Disk Partitioning

The most common method of partitioning a hard disk drive is to create one large "Primary DOS Partition" which occupies all the disk space. However, many people prefer to "split" their hard disk drive into two partitions, so that it looks like two (or more) individual drives (eg, C: and D:).

Why would you want to do this? Well, there are several reasons. First, it allows you to keep your work files completely separate from program and system files. This makes accidental deletion of vital program and system files far less likely, makes it much easier to do routine data backups and allows for faster defragging of the work "disk".

Second, splitting a hard disk drive into multiple partitions is the way to go if you want to set up a dual-boot or triple-boot operating system. For example, you might want a dual-boot system that lets you to choose between Windows Me and Windows NT, or between Windows Me and Linux. By far the best way to set this up is to install each operating system into its own partition.

Basically, you can split a hard disk drive into just two partitions: (1) a Primary DOS Partition; and (2) an Extended DOS Partition. The primary partition becomes the C: drive but you can create as many logical drives in the extended partition as you wish.

If you install an OEM (or full) version of WinMe on a new hard disk, the setup routine will automatically create a single "Primary DOS Partition" on the hard disk. So how do you create multiple partitions?

The answer is that you have to manually create the partitions using the **fdisk** utility (this is included on the CD-ROM). To do this, you boot from the CD-ROM as before but this time you select "Start Computer With CD-ROM Support" from the menu (instead of "Start Windows Me Setup from CD-ROM"). This boots the computer to a DOS prompt and creates a "RAM disk" with the system tools in it.

Typing **fdisk** initially brings up a

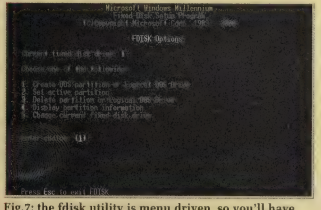


Fig.7: the fdisk utility is menu driven, so you'll have no trouble finding your way around. You can either create one primary DOS partition, or split the disk into two separate partitions – primary and extended.

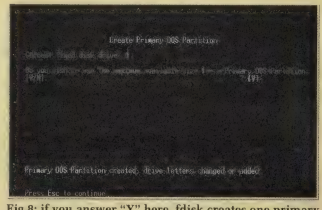


Fig.8: if you answer "Y" here, fdisk creates one primary DOS partition that occupies all the available space. Answering "N" lets you specify the size of the primary partition and then create an extended partition.

(3) Copying Windows files to the computer;
(4) Restarting the computer; and
(5) Setting up hardware and finalising settings.

It might look a tad intimidating but it's really all bouncing ball stuff that's easy even for a novice to follow. Most of the procedure is automatic and you just have to fill in a few details and make a few choices along the way.

In particular, you have to fill in the "Product Key" (found on the back of the CD-ROM case) and choose the type of system you want installed when you get to the "Setup Options" menu – either Typical, Portable, Compact or Custom. Take my tip and go for the Custom setup. This lets you add components that are not installed by default and delete space-consuming features that you don't want.

My advice is to leave out as much clutter as possible. This includes unnecessary stuff such as Destop Themes wallpaper, sounds, fancy mouse pointers and other features. After all, why slow down a PC by loading wallpaper or other fancy background themes? Always keep your desktop clean and simple – you'll get better performance if you do.

For the same reason, you should also later resist the temptation to have lots of programs automatically start up at boot time. Everything you load runs in the background and hogs system resources, so keep as much stuff out of the Startup folder as possible.

Other stuff that can usually go are the Accessibility items and the Online Services. You can also deselect "Disk Compression" (found under System Tools) if you don't intend running compressed disks. While you're here, it's usually not a bad idea to select the following items: Character Map, Clipboard Viewer, Net Watcher (for monitoring network connections if you have a network); System Monitor and System Resource Meter.

A lot of the items under "Communications" can also be deselected but be sure to select "Dial-Up Networking" if you intend connecting to the Internet. You should also select "Internet Connection Sharing" if you intend using the machine to share an Internet connection with other machines on a network.

dialog box that asks whether you wish to enable large disk support (ie, the FAT32 file system). It's necessary to answer "Y" (yes) here if you want the operating system to "see" partitions greater than 2.1GB. After that, the screen shown in Fig.7 appears and you simply follow the menus to partition the drive.

Assuming an unpartitioned drive, you first select option 1 to create a DOS partition and then option 1 again to create a primary DOS partition. If you allocate all of the disk space to the primary partition, then that's the end of the matter and you finish up with just one logical drive (ie, C:).

Alternatively, if you allocate only part of the space to the primary partition, you can then create an extended partition to cover all or some of the remaining disk space.

After that, you can create one or more logical drives in the extended partition. These logical drives automatically take on the next drive letters in the sequence (ie, D:, E:, etc).

Typically, you might want to split a 20GB hard drive so that it has a 6GB primary partition and a 14GB extended partition with a single logical drive. This means that your machine would appear to have two hard disk drives – a 6GB C: drive and a 14GB D: drive. Of course, you can make the partitions any size you want.

By the way, you have to set the C: partition as the "Active" partition. This designates which partition contains the boot sector – ie, it determines where the boot files are stored.

Once the partitions have been created, you need to format each of the logical drives in turn. You'll find the format utility (format.com) in the \WinMe folder on the CD-ROM, so you'll need to change to this folder before running this command.

For example, let's say that you have two logical drives (C: and D:) and that your CD-ROM is at E:. First, you'll need to change to the CD-ROM drive by typing **E: <Enter>** at the DOS prompt and then typing **cd \WinMe** to change to the \WinMe folder.

Once there, you can format the C: drive by typing **format c:** at the prompt. When the format is complete, you can then format any remaining drives in exactly the same manner. It's also a good idea to run the scandisk utility on each of the drives, to verify the drive integrity.

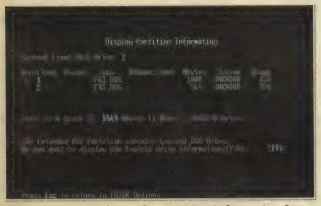


Fig.9: this screen shows the partition information for a 1.6GB drive that's between split into two partitions. The primary partition occupies 65% of the drive space, while the extended partition occupies the remainder.

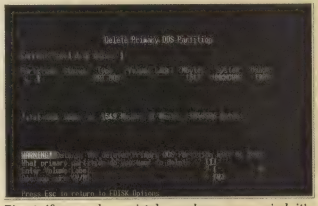


Fig.10: if you make a mistake or change your mind, it's just a matter of deleted the existing partition(s) and starting again. Warning: all data on a hard disk drive is lost when you alter partitions using fdisk.

It's largely a matter of personal preference as to what you keep and leave out. And, of course, you can always add wanted items and delete any unnecessary features after the operating system has been installed (this is done using the Add/Remove Programs utility in Control Panel).

Along the way, you will be directed to create a Startup disk so be sure to set aside a clean floppy disk before starting the installation. You'll also be prompted to choose a keyboard type – the US 101-key keyboard is the one to go for in Australia.

At this stage, the system will begin copying files to the hard disk drive. This will probably take 20-30 minutes or more, depending on the speed of your CD-ROM drive.

During this process, the Setup Wizard automatically restarts the computer several times and there's a great deal of disk activity as the system identifies the hardware configuration and copies the relevant files across. Towards the end, you will be prompted for a password. If you don't want a password, leave the password field blank.

Final setup

Once the installation is complete, the system should automatically boot into Windows but there may be a few problems to solve. In our case, the system booted with a grey desktop as shown in Fig.4 – nothing like the default dark-blue desktop normally expected with WinMe.

What's happened here is that the system has installed a generic driver for the video card. That's easily checked out in the Device Manager and this will also highlight any other problems that may be lurking.

In fact, once the system is running, the Device Manager should be your first port of call. You can start it by double-clicking the System icon in Control Panel and then clicking the Device Manager tab on the resulting System Properties dialog box. This lists all the items that are currently installed on your system and allows you to check that all devices are working correctly.

A yellow exclamation mark or a red cross next to any item indicates a problem.

Installing The Driver For The Promise Ultra ATA100 Controller

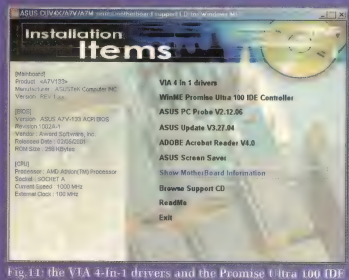


Fig.11: the VIA 4-In-1 drivers and the Promise Ultra 100 IDE Controller driver are installed from the CD-ROM supplied with the motherboard. The CD-ROM auto-starts when placed in the drive.

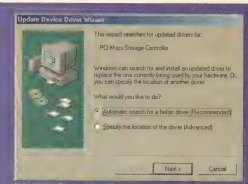


Fig.12: the wizard automatically searches the CD-ROM for the best driver or you can specify the path to the driver yourself.

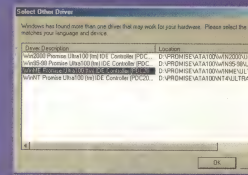


Fig.13: this list shows the drivers found by the automatic search routine. Choose the one that matches the installed operating system.

In our case, the Device Manager revealed two problems – see Fig.5. First, it showed that a "Standard PCI Graphics Adapter (VGA)" had been installed for the video card (something that we already expected). Second, it showed that we needed to install a driver for something called a "PCI Mass Storage Controller".

These two problems were easily solved. First, the video driver – this is supplied on a CD-ROM which autostarts to bring up the dialog box shown in Fig.6. Clicking the "Install Driver" button then did the trick. This automatically installed the correct driver, after which the machine booted to a nice blue desktop.

The "PCI Mass Storage Controller" that WinMe found during setup is actually the Promise Ultra ATA100 IDE controller. Getting this working correctly is just a matter of installing the drivers from the CD-ROM supplied with the motherboard.

This CD autostarts to the dialog box shown in Fig.11. Install the "Via 4-in-1 Drivers" update first, then install the driver for the Promise Ultra ATA100 controller. Actually, clicking the button here doesn't automatically install the driver. Instead, it brings up a small text file which instructs you how to do this manually.

The procedure is straightforward – select the "PCI Mass Storage Controller" entry in Device Manager, click the Properties button and select the Driver tab to update the driver. You can then either do an automatic search for the driver or manually specify the driver's location (Fig.12).

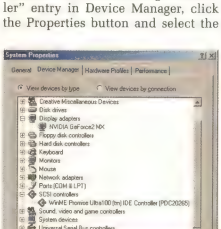


Fig.14: this is what the System properties dialog box looks like after the correct drivers have been installed for the video card and the Promise Ultra 100 IDE Controller.

An automatic search eventually brings up the dialog box shown in Fig.13 and it's then just a matter of selecting the driver that matches the operating system (WinMe in this case).

Manually specifying the location of the driver is quicker though – you just browse to the folder that has the driver. In our case, the required driver is in D:\Promise\ATA100\WINME (D: is the drive letter for the CD-ROM drive).

Once we'd done all that, the driver entries for the video card and the Promise Ultra ATA100 Controller appeared as shown in Fig.14. Note that the Promise driver is listed under SCSI controllers, even though it's not a true SCSI device. This is perfectly normal.

Fig.14 also shows the driver entries that appeared after we installed the sound card.

Installing other drivers

If any other devices are causing problems, you can update the driver in exactly the same manner. Usually,

it's just a matter of clicking the Update Driver button in Device Manager and then letting the system automatically search for a driver on the CD-ROM or floppy disk supplied with the device. If it finds more than one driver, it's then simply a matter of choosing the correct one for your operating system from the list.

Alternatively, you can manually specify the location of the driver by browsing to the correct folder on the CD-ROM or floppy disk yourself. Be sure to check out any readme files on the driver disk for installation instructions.

Another technique for dealing with problem devices (ie, those with yellow exclamation marks or red crosses beside them) is to remove them from the Device Manager and reboot. The system will then rediscover the new device as it boots and prompt you for the driver disk. Again, you can do an automatic search for the driver or specify the location yourself.

Adjusting The Display Properties

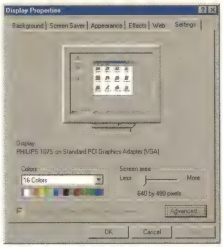


Fig.15: this screen grab shows the default display settings that were installed by Windows Me. It installed a generic video driver at 640 x 480 pixels and just 16 colours.

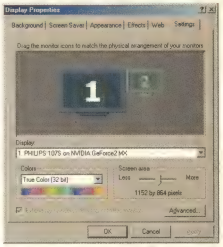


Fig.16: once the correct video driver has been installed, you can adjust the display settings as shown here. Clicking the advanced button gives you lots of other settings to play with.

Setting the display resolution

Once you have the correct driver installed for the graphics card, you'll want to set the display resolution to something better than the 640 x 480 default. To do this, right-click on the desktop and choose Properties to bring up the Display Properties dialog box (Fig.15). Now click the Settings tab and drag the slider to the right to increase the display resolution.

A resolution of 1152 x 864 is about right for a 17-inch monitor but you can vary this to suit yourself – see Fig.16.

While you're here, you will also want to change the number of displayed colours from the drop-down list to the left of the slider. Depending on your graphics card, choose either "High Color (16-bit)" or "True Color (32-bit)", then click the Apply button. Windows will then resize the desktop for 15-seconds, after which you can

Clean Installing The Windows Me Upgrade Version

If you are clean installing an upgrade version of WinMe onto a hard disk, you won't be able to boot from the CD-ROM. This means that you'll need a WinMe or Win98 startup floppy in order to start your system. These startup floppies also include the necessary utilities to allow you to partition and format the disk drive, and include drivers for CD-ROM support.

If you're upgrading from an old computer, you'll need to make a startup floppy before trashing the system. It's easy enough to do – just insert a floppy disk in the drive, open "Add/Remove Programs" in Control Panel, click the Startup Disk tab and then click the Create Disk button.

If you've already trashed the system, you'll have to beg, borrow or steal a startup disk from somewhere. But be careful – you don't want your new machine to start life with a virus on board.

Note that you will have to change the system BIOS, so that the floppy disk drive is first in the boot order. If you don't do that, the system will try to boot from one of the other drives first and you'll get a "Non-system disk" error message.

When you boot from the startup disk, a menu appears giving you the option to start the computer with or without CD-ROM support. The startup floppy first loads the CD-ROM driver (if this option is selected), then loads a 2MB RAM drive. This RAM drive includes ***format.com*** plus several diagnostic tools.

Note that the RAM drive will push your CD-ROM drive back one letter. This means that if your CD-ROM is usually drive D:, it will now become drive E:. In any case, an on-screen message tells you what the drive letters are, so you don't have to figure it out.

After that, you can partition and format the drive(s) in the usual manner. You then boot the machine with CD-ROM support, switch to the CD-ROM drive and type ***Setup*** at the command prompt to run the Windows Me installation wizard.

During installation, the system will perform a "compliance" check to make sure that you're entitled to use the lower-cost product. Typically, it does this by checking the hard disk drive for an earlier version of the operating system but you can also install an upgrade version onto a freshly formatted drive. How? – easy; just insert the CD-ROM for your earlier version when prompted to do so.

If you are upgrading from Win98 to WinMe, for example, all you have to do is "show" the system your Win98 CD-ROM for compliance checking. In fact, you can even show a Win98 upgrade CD-ROM (eg, if you've previously used this to upgrade from Win95) and the system will be happy with this.

Once compliance checking is complete, you re-insert the upgrade CD-ROM and the installation proceeds as normal.

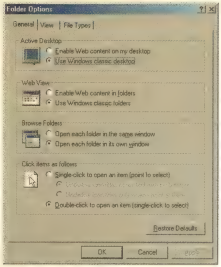


Fig.17: the Folder Options dialog lets you set Windows up to satisfy your personal preferences.

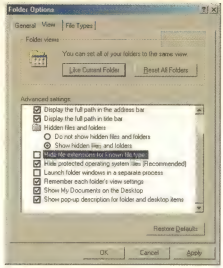


Fig.18: clicking the "View" tab gives you other options to choose from. Choose the options that suit you best.

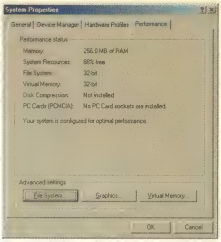


Fig.19: clicking the "Performance" tab in the System properties dialog box should show the message "Your system is configured for optimal performance".

choose to either accept or discard the new settings.

Clicking the Advanced button will allow you to change the monitor driver and to adjust other parameters specific to the graphics card. In our case, the Philips 107S monitor (which is Plug 'n Play) was correctly identified and its driver installed during the WinMe setup, so we didn't have to bother with this.

If you have a different monitor, then it may be necessary to install the driver yourself from the supplied CD.

Windows Me directly supports DVD-ROM drives, so there is no need to install additional drivers for this device. You might, however, want to install the software that's supplied with the DVD-ROM drive (this will install a DVD player (Fig.23).

Installing the sound card

Now let's get that sound card going. Power off, plug the card into a vacant PCI slot (don't forget to connect the audio cable from the DVD-ROM drive) and switch on. The system will find the new hardware as it boots and prompt you to install the driver. It's then just a matter of placing the Sound Blaster Live CD-ROM in the drive, and specifying the location for the driver on the CD-ROM by browsing to D:\AUDIO\ENGLISH\WIN9XDRV.

Alternatively, you can allow the system to automatically search for the driver and then select the correct driver from the resulting list.

The system will then complete the reboot, after which your sound card should be fully functioning.

By the way, there are lots of other goodies on the Sound Blaster CD-ROM for you to install. Just re-insert the CD-ROM to auto-run the install dialog box and go from there. You'll probably also want to install Acrobat Reader so that you can read the Sound Blaster manual that's on the CD-ROM.

Other hardware items (eg, ZIP drives, CD-ROM burners, network cards, etc), can now be added to your new PC. It's always best to install these

Asus Probe: Watching Over Your System's Health

Fig.20: the Asus Probe summary screen let's you check the system "health" at a glance.

Fig.21: this screen lets you set the alarm thresholds for the CPU and motherboard temperature.

Fig.22: the SoundBlaster sound card comes with a bewildering array of software, including "Rythmania" (above), "Media Ring Talk" for Internet phone calls (top, right) and a Surround Mixer, Recorder, Play Center and Application Launcher (right). There's lots more, as well.

Fig.23: the DVD-player software installs this dedicated DVD-player utility.

one at a time and get each new device working before installing the next.

Personal preferences

There are a few adjustments that you might like to make to the appearance of the desktop, to satisfy your personal preferences. For example, if you want a Windows classic desktop rather than web-enabled content, just click Tools -> Options in Explorer to bring up the Folder Options dialog box shown in Fig.17 and make your selections.

It really is a matter of personal preference here.

Clicking the View tab brings up the dialog box shown in Fig.18. Personally, I always like to select the "Show hidden files and folders" options and choose not to "Hide file extensions of known file types" (ie, I want to see the file extensions).

You should also check that your system is configured for optimal performance by clicking the Performance tab on the System Properties dialog box – see Fig.19.

Asus Probe

It's a good idea to install the Asus Probe utility from the motherboard CD-ROM. This handy utility runs in the background and continuously monitors the system "health", including the CPU fan speed, the CPU and motherboard temperatures and various voltage levels. It can be set to launch automatically at system startup and could save you big bucks if there's a simple hardware failure.

That's it – don't forget to visit the Windows Update site when you've finished. You should also download and install any updated device drivers; eg, for the video card. **SC**

RAID 0 vs RAID 1: Disk Striping & Disk Mirroring

As stated in Pt.1 in the June issue, the Promise controller on the Asus A7V133 motherboard supports a feature called "RAID 0". The article then went on to describe RAID 0 as disk mirroring but this is incorrect.

RAID 0 (also known as "data striping") is actually a technique that "stripes" the data across two identical disk drives. It allows you to combine the two drives into one logical partition and splits the data evenly between them.

This effectively doubles the data transfer rate because only half the data is written to each drive and the drives operate in parallel. The setup procedure is fully described in the manual.

The downside is that RAID 0 offers no data protection at all. In fact, it actually increases the risk of failure because if one drive fails, all the data on the RAID array is lost.

The disk mirroring technique referred to in Pt.1 is actually known as RAID 1 and is not directly supported by the Asus A7V133 motherboard.

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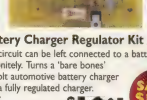

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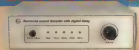

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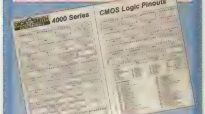

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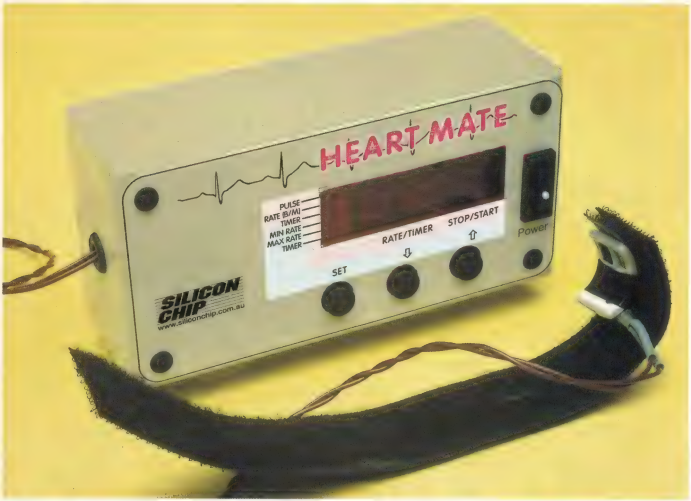


HEARTMATE

Build it & keep tabs on your ticker

Got a treadmill or exercise bike to help you keep fit? How do you know whether you are overdoing it? Build this Heart Rate Monitor and stop yourself carking it. You can monitor your pulse beat rate to maintain it within certain limits. There is a timer to limit the duration of your exercise, minimum and maximum pulse rate buzzers and a recovery rate display.

By JOHN CLARKE

YEAH, YEAH we know there are plenty of miniature heart rate monitors for people who want to jog but they don't include all the handy features of the SILICON CHIP Heart Rate Monitor. It will display pulse rates up to 235 beats/minute and has a number of preset buzzers to help you in your exercise program.

A Heart Rate Monitor is an essential piece of equipment when you are exercising as you can maintain your pulse rate at the desired level.

Fig.1 shows target pulse rates for people aged between 20 and 70. The target range is the pulse rate needed in order to provide suitable exercise for the heart. For a 25-year old, this range is about 140-170 beats per minute while for a 60-year old it is typically between 115 and 140 beats per minute. It is important not to overdo it. If you begin to feel weak and light headed, stop immediately.

The SILICON CHIP Heart Rate Monitor has an audible buzzer which can be set to sound if your pulse rate falls outside the target range that you set. And having exercised within the target range for a preset time, a buzzer will sound to tell you to have a rest.

Feeling completely knackered? The SILICON CHIP Heart Rate Monitor will monitor your recovery. This is the time to recover to your normal resting pulse rate after the exercise period. If you are really fit, your recovery time will be quick and if you are not (like most of us), it will be a lot slower.

The SILICON CHIP Heart Rate Monitor is housed in a small plastic case which can be mounted onto the handle bars of your exercise machine, be it an exercise bike, treadmill or whatever. It is powered from a 9-12V DC plugpack so there are no batteries to go flat. The 3-digit display uses 7-segment LEDs which are bright and easier to see than small LCD units.

It has three pushbuttons to control its operation and a column of LEDs to indicate the current function or reading on the display.

The pulse detector is a finger stall with an inbuilt infrared LED and infrared detector. The finger stall is held onto your finger with a strip of Velcro (hook and loop).

The Heart Rate Monitor shows pulse rates from 26 beats per minute to 235 beats per minute on its 3-digit display. If your pulse rate is below 26b/m you are either a lizard or you are dead.

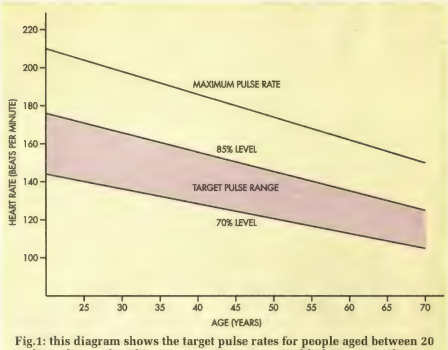


Fig.1: this diagram shows the target pulse rates for people aged between 20 and 70 when undertaking exercise. For a 25-year old, the range is about 140-170 beats per minute, while for a 60-year old, the target range is about 115-140 beats per minute.

Either way, it will be displayed as "Err" on the display. Actually the most likely possibility is that the fingerstall is not properly attached to your finger.

At the other end of the scale, measured pulse rates above the 235b/m limit will be displayed as three dashes (---).

When the heart detector is working properly, the top-most LED in the LED column flashes in unison with each pulse. The 3-digit display is updated on every second pulse. When the pulse rate is being displayed, the second LED in the column is also lit.

A piezo buzzer will momentarily sound if your pulse rate goes above or below preset values.

The Timer setting can be displayed by pressing the rate/timer switch and this also lights the Timer LED in the column display.

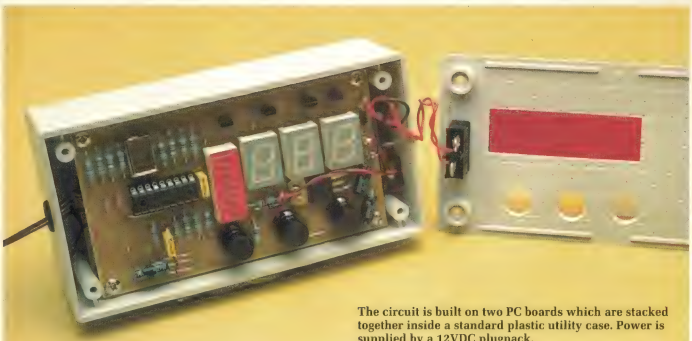
The SET switch is used to display the three presets. Pressing the SET switch selects the minimum pulse rate display and lights up the "Rate min" LED. The minimum pulse rate value can then be adjusted using the up and down pushbuttons. The inbuilt (default) setting is 130b/m. Once a new value is selected, it is stored in memory regardless of whether the power is on or off.

Pressing the SET switch again lets you set the maximum pulse rate and also lights the "Rate max" LED. The inbuilt setting is 160b/m. The SET switch will also display the timer setting and light the Timer LED. Then you can adjust the setting from one minute to 255 minutes (4 hours 15 minutes) in one-minute steps using the up and down switches. The initial setting is 30 minutes.

To start the timing period, press the Start/Stop switch when the display is showing either the pulse rate or cur-

Main Features

- Ideal for use with exercise machines
- Adjustable timer with buzzer
- Visible pulse indicator
- Timer end buzzer
- Timer stops below minimum pulse beat rate
- Start/stop timer control
- Recovery display 1,2,3,4 & 5 minutes
- Error display for no pulse
- Minimum & maximum pulse settings for audible buzzer



The circuit is built on two PC boards which are stacked together inside a standard plastic utility case. Power is supplied by a 12VDC plugpack.

rent timer setting. The timer will count down from its preset value if the pulse rate is above the minimum setting and the LEDs in the column will begin chasing.

When the buzzer sounds, a LED will flash to explain the warning. For example, if your pulse is racing above the set maximum, the buzzer sounds and the "Max rate" LED flashes.

Similarly, if there is an error in detecting the pulse, the display will show "Err" and the "Rate min" LED will flash. This will stop the exercise timer. You can start the timer again with the Stop/Start switch but the timer will only begin counting down when the minimum pulse rate has been reached. The buzzer will also sound when the timer has counted down to zero.

Recovery mode

At the end of the timer countdown, the Heart Rate Monitor goes into the Recovery mode. For the next five minutes the display will show REC, then the current timer value, then REC and the current pulse rate. The corresponding Pulse Timer LEDs will be displayed as each reading is shown. At one-minute intervals, the buzzer will sound and current heart beat rate will be stored in memory, referenced to the current minute. If there is an error in the reading, then the pulse value will be zero.

At the beginning of the recovery period, the minute display will show "-0" to indicate that the timer is less than one minute into the recovery period. After one minute the display will show "-1" and then -2, -3, -4 and -5 at each successive minute.

At the end of the five minutes, the display changes to show the pulse rates stored at each minute interval. The display will show REC, then "-0" and then the stored pulse rate. It then shows "-1" and the next stored pulse rate and so on.

The display will continue to cycle through these values until either the unit is switched off or a switch is pressed. Pressing a switch will return the unit to the pulse mode.

Circuit description

Now let's have a look at the circuit of Fig.2. IC1 is the PIC16F84 microcontroller which is the heart of the circuit.

Three 7-segment displays DISP1-DISP3 and a bargraph LED display DISP4 are driven directly from the RB1-RB7 outputs of IC1 via 150Ω limiting resistors. This is a multiplexed display arrangement with all the "a" segments on DISP1, DISP2 & DISP3 tied together and the same comment applies to the "b" segments and the "c", "d", "e", "f" & "g" segments. The LEDs within DISP4 are tied to the "b", "a", "f", "g", "e" and "d" segments, respectively.

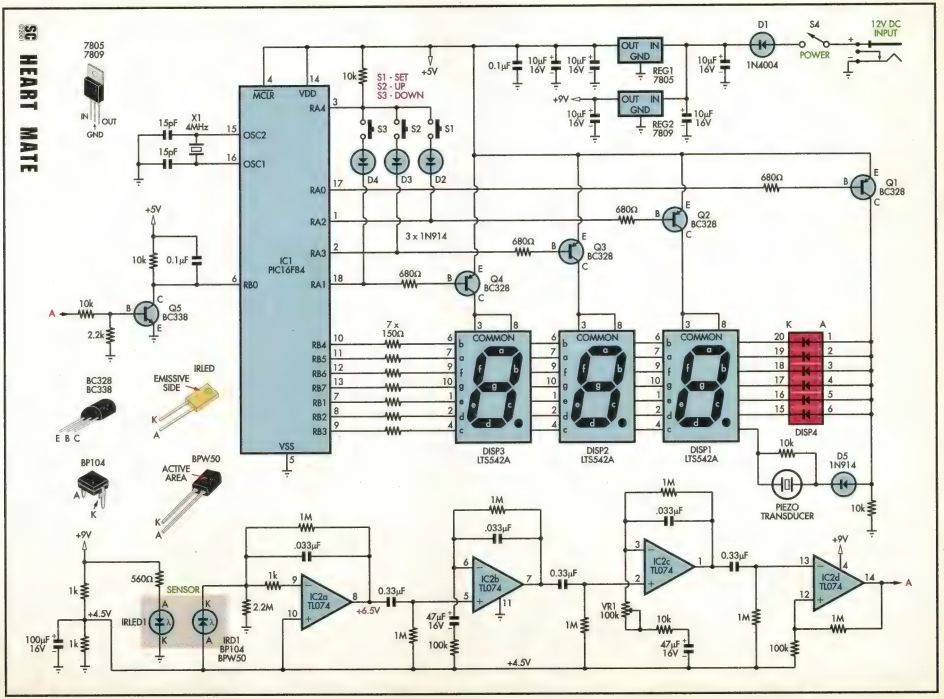
The LED displays have their common anodes driven by transistors Q1-Q4 from the RA0, RA1, RA2 and RA3 lines of IC1.

For example, if RA0 is brought low, transistor Q1 will be switched on to apply power to the common anode of the LEDs in DISP4. At the same time, a low output on RB1-RB7 will light the corresponding LED in the display.

After DISP4 has been lit for about 1ms, the RA0 output is taken high and the RA2 line is brought low to drive Q2 and display DISP1. The new 7-segment data on the RB1-RB7 lines is presented to DISP1 for the next 1ms. Then the RA1 line is brought low to drive DISP3 and so on.

Note that the "c" segment output from RB3 also connects to one side of the piezo transducer while the other side is driven by transistor Q1 via diode D5. However, the piezo transducer is driven only when DISP4 is on and only if the RB3 output is brought low at this time. If it is driven,

Fig.2 (right): the circuit is based on a PIC microcontroller (IC1) which drives three 7-segment LED displays and a LED bargraph. IRD1 and RD1 form the infrared pickup – its output is processed by op amps IC2a-IC2d and used to drive the RB0 input of IC1 via transistor Q5.


7805
7809
IN
OUT
GND
15pF
X1
4MHz
15pF
OSC2
OSC1
MCLR
VDD
VSS
IC1
PIC16F84
RA4
RA0
RA2
RA3
RA1
RB0
RB4
RB5
RB6
RB7
RB1
RB2
RB3
10k
+5V
S1 - SET
S2 - UP
S3 - DOWN
S3
S2
S1
D4
D3
D2
3 x 1N914
0.1µF
10µF 16V
OUT IN GND
REG1 7805
REG2 7809
+9V
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S4
POWER
12V DC INPUT
680Ω
Q1 BC328
Q2 BC328
Q3 BC328
Q4 BC328
Q5 BC338
2.2k
7 x 150Ω
COMMON
DISP3 LTS542A
DISP2 LTS542A
DISP1 LTS542A
DISP4
K
A
10k
D5 1N914
PIEZO TRANSDUCER
BC328
BC338
E B C
IRLED
EMISSIVE SIDE
BP104
BPW50
ACTIVE AREA
1M
.033µF
0.33µF
IC2a TL074
IC2b TL074
IC2c TL074
IC2d TL074
+6.5V
+4.5V
1k
560Ω
SENSOR
IRLED1
IRD1
BP104
BPW50
2.2M
47µF 16V
100k
VR1 100k
100µF 16V

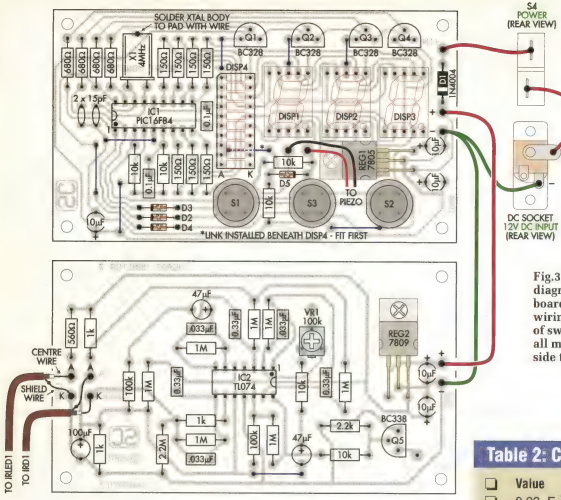


Fig.3: follow this layout diagram to build the PC boards and complete the wiring. Note the orientation of switches S1-S3 – they are all mounted with their flat side to the left.

it effectively gets a 1ms pulse every 4ms, an effective frequency of 250Hz.

Diode D5 isolates the transducer from the circuit if the RB3 line is high and Q1 is off. The 10kΩ resistor across the transducer discharges its capacitance between each forward pulse.

The Set, Up and Down switches (S1-S3) are monitored by the RA4 input. These switches also connect to the RA2, RA3 & RA1 outputs respectively via diodes D2, D3 & D4. Normally, RA4 is held high via the 10kΩ resistor connected to the +5V supply. Depending on whether RA1, RA2 or RA3 is low when a switch is closed, IC1 will respond with a programmed action.

Diodes D2, D3 & D4 are included to prevent the RA1, RA2 & RA3 lines from being shorted if more than one switch is pressed at the same time.

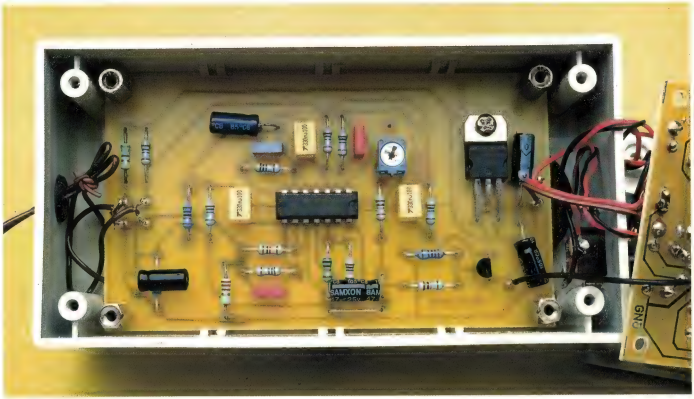
Table 2: Capacitor Codes

Value	IEC Code	EIA Code
0.33μF	334	330n
0.1μF	104	100n
.033μF	333	33n
15pF	15	15p

IC1 runs at 4MHz due to the crystal (X1) connected to pins 15 & 16. This frequency is divided by four for the internal operation of the microprocessor. An internal counter further divides this by four and then by 250. The resulting signal drives the dis-

Table 1: Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	2.2MΩ	red red green brown	red red black yellow brown
7	1MΩ	brown black green brown	brown black black yellow brown
2	100kΩ	brown black yellow brown	brown black black orange brown
6	10kΩ	brown black orange brown	brown black black red brown
1	2.2kΩ	red red red brown	red red black brown brown
3	1kΩ	brown black red brown	brown black black brown brown
4	680Ω	blue grey brown brown	blue grey black black brown
1	560Ω	green blue brown brown	green blue black black brown
7	150Ω	brown green brown brown	brown green black black brown



The signal processing board is fitted with 15mm tapped spacers and is mounted in the bottom of the case by clipping it into the integral side slots. The display PC board is then secured to the tops if the spacers using machine screws.

play multiplexing at 1kHz. Further division by 1000 provides us with a pulse once every minute which updates the timer.

The pulse signal is applied to the RB0 input of IC1 which interrupts the program whenever this input goes high. Internally to IC1, there is a counter which counts how many 2ms intervals there are between two heart beat pulses. This number is then divided into 60,000 and the result is the pulse rate. For example, if the pulse rate is 60b/m (beats per minute) there will be a pulse every second. The duration of two heart beats will be two seconds or 1000 x 2ms. Dividing 1000 into 60,000 will give the correct result of 60 which is shown on the display.

The actual update period for the pulse display is once every second heart pulse. So the update is every 2 seconds at 60b/m, once every second for 120b/m and so on.

Detection of the pulse is via an optically-coupled pickup using an infrared LED (IRLED1) and a photo diode (IRD1). The infrared LED is powered from the +9V supply via a 560Ω resistor and its light shines into the flesh of your finger and is reflected off the bone. The pulsating blood through the vessels modulates the amount of light being detected by the infrared diode IRD1.

Op amp IC2a is connected as a current-to-voltage converter for IRD1 which exhibits a varying reverse current in response to the changing light from the finger. The anode of IRD1 and the non-inverting input to IC2a is biassed at +4.5V. Pin 9 is the inverting input and the cathode of IRD1 connects to this via a 1kΩ stopper resistor. The gain of IC2a is set by the 1MΩ resistor between pin 8 and the cathode of IRD1 while the .033µF capacitor provides high frequency rolloff above 4.82Hz. This is to attenuate 50Hz mains signals which might otherwise be amplified.

Note that there is also a 2.2MΩ resistor from the cathode of IRD1 to ground. This makes IC2a function as an inverting DC amplifier with a gain of -0.45 and this causes pin 8 to sit at about +6.5V. The resulting current through the 1MΩ resistor to the 2.2MΩ resistor is enough to provide a very

The piezo transducer is secured to the bottom of the case using machine screws and nuts, while the DC power socket is mounted on the side. Make sure that none of the mounting screws can foul the PC board.

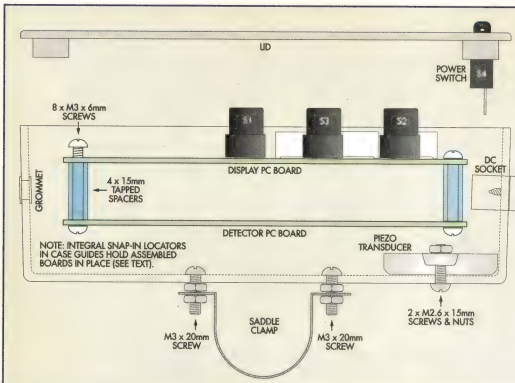


Fig.4: here's how it all goes together inside the plastic case. The snap-in locators in the case guides hold the PC boards in place.

small reverse bias current through IRD1 and thereby ensure that it works at maximum sensitivity.

The output of IC2a is AC-coupled via a 0.33µF capacitor, giving a low frequency rolloff below 0.48Hz or the equivalent of 29 beats per minute. IC2b has a gain of 11, set by the 1MΩ feedback resistor and the 100kΩ resistor connecting from pin 6 to the +4.5V rail. The 47µF capacitor provides a rolloff below .03Hz. The .033µF capacitor across the 1MΩ resistor gives the same high frequency rolloff as in IC2a.

IC2c is almost identical to IC2b except that it includes a gain control, VR1. IC2c's output is AC-coupled to op amp IC2d which is connected a Schmitt trigger, by virtue of the positive feedback applied by the 1MΩ resistor between pins 12 & 14. The output drives the base of transistor Q5 via a 10kΩ resistor to provide the pulse signal to pin 6 of IC1.

Power for the circuit comes from a 9V or 12V DC plugpack via diode D1 and power switch S4, to feed two 3-terminal regulators.

REG1 produces +5V while REG2 produces +9V. The 9V supply is divided by two series 1kΩ resistors to give a +4.5V supply to bias the inputs of IC2.

Construction

The Heart Rate Monitor is constructed on two PC boards. Board 1, coded 04107011 and measuring 105 x 62mm, contains the displays and microcontroller, IC1. Board 2, coded 04107012 and measuring 105 x 62mm, contains the amplifier circuitry for

The U-shaped metal bracket on the back of the unit allows it to be attached to the handlebars of an exercise bike or treadmill.

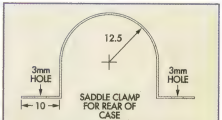


Fig.5: the mounting clamp details. It attaches to the base of the case using two M3 x 20mm screws and M3 nuts.

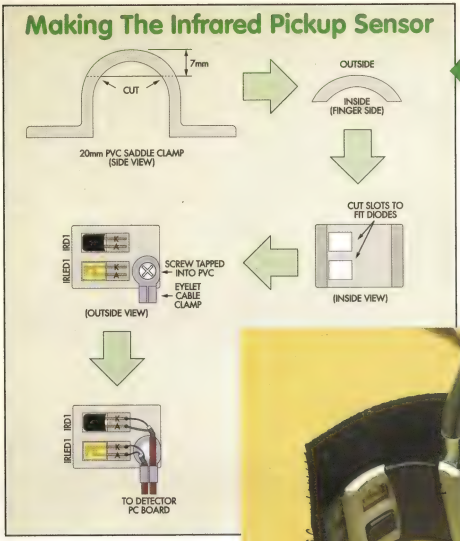
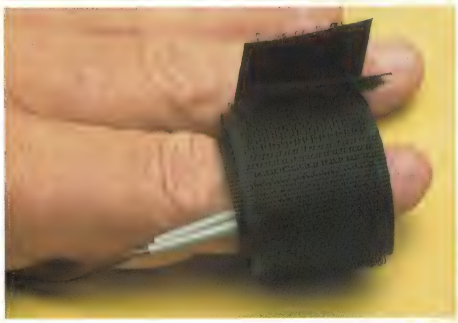


Fig.6 (left): how the infrared pulse sensor is made. The infrared transmitting and receiving LEDs are fitted side-by-side into two slots that are cut into a PVC saddle clamp section.

Below: the pulse sensor assembly is fitted with a length of Velcro so that it can be held in position on your finger. You can use contact adhesive to secure the Velcro to the PVC section.



the pulse sensors. The two boards are stacked together and housed in a plastic case measuring 130 x 67 x 44mm. The full wiring details for both boards are shown in Fig.3.

Begin construction by checking the PC boards for shorts between tracks or any breaks in the copper connections. Compare the patterns with the published artwork to be sure they are correct. Check hole sizes. The corner mounting holes and regulator tab mounting holes should be 3mm in diameter. The holes for the PC stakes should be drilled to give a tight fit for these.

You can work on both PC boards together. Insert the PC stakes first, followed by the links and resistors. Use the resistor colour codes in Table 1 when selecting the resistors and use a digital multimeter to check each one before it is installed.

Next, insert and solder in the diodes, making sure that they are ori-

Parts List

1 PC board, code 04107011, 105 x 62mm
1 PC board, code 04107012, 105 x 62mm
1 front panel label, 125 x 63mm
1 plastic case, 130 x 67 x 44mm
1 transparent red Perspex or Acrylic sheet, 56 x 18mm x 2.5mm
1 DC panel socket (plus self-tapping screws if required)
1 9V or 12V DC 300mA plugpack
3 snap-action keyboard switches (S1,S2,S3)
1 miniature SPST rocker switch (S4)
1 4MHz parallel resonant crystal (X1)
1 piezo transducer
1 18-pin DIL socket
4 M3 x 15mm tapped standoffs
10 M3 x 6mm screws
2 M3 x 20mm screws
1 M3 x 6mm countersunk screw
6 M3 nuts
2 M2.6 x 15mm screws
2 M2.6 nuts
1 small rubber grommet
1 crimp eyelet with 3mm eyelet hole
13 PC stakes
1 25.4mm saddle clamp
1 200mm length of 25mm wide hook and loop tape (Velcro)
1 20mm saddle clamp (used for conduit)
1 10mm length of 12.5mm diameter heatshrink tubing
1 120mm length of 0.8mm tinned copper wire
1 50mm length of red medium duty hookup wire
1 50mm length of black medium duty hookup wire
1 50mm length of green medium duty hookup wire
1 800mm length of single core screened cable (small diameter type)
1 100kΩ horizontal trimpot (VR1)

Semiconductors

1 PIC16F84P microprocessor programmed with HEART.HEX (IC1)
1 TL074 quad op amp (IC2)
3 LTS542A 7-segment common anode red displays (DISP1-DISP3)
1 DIL 10-LED (red) bargraph (DISP4)
1 photo interrupter for IRLED1 (Jaycar Cat. Z-1901 or equivalent)
1 IR photo-diode BP104, BP104, (IRD1)
1 7805 5V 1A regulator (REG1)
1 7809 9V 1A regulator (REG2)
4 BC328 PNP transistors (Q1-Q4)
1 BC338 NPN transistor (Q5)
1 1N4004 1A diode (D1)
4 1N914, 1N4148 switching diodes (D2-D5)

Capacitors

1 100µF 16VW PC electrolytic
2 47µF 16VW PC electrolytic
5 10µF 16VW PC electrolytic
3 0.33µF MKT polyester
2 0.1µF MKT polyester
3 .033µF MKT polyester
2 15pF NP0 ceramic

Resistors (0.25W, 1%)

1 2.2MΩ	3 1kΩ
7 1MΩ	4 680Ω
2 100kΩ	1 560Ω
6 10kΩ	7 150Ω
1 2.2kΩ	

ented correctly. Note that D1 is a 1N4004. The 7-segment displays are inserted with the decimal point facing toward the switches. DISP4 should be inserted with the label side towards IC1. Insert the socket for IC1 with its pin 1 oriented as shown in Fig.3. IC2 can be soldered directly into the PC board.

Now insert the capacitors. The electrolytic types must be oriented correctly with the positive side placed as shown on the overlay diagram and with each one laid over on its side, as shown in the photographs, to allow the PC boards to be stacked. For the same reason, the crystal is placed on its side and is secured at its free end using a short length of tinned copper wire soldered to the PC board.

When inserting the pushbutton switches make sure that the flat sides are oriented as shown. The four transistors Q1-Q4 should be inserted so that their tops are level with the top of the displays. Q5 is the BC338 and it does not need to be inserted so far into the PC board. REG1 & REG2 are mounted horizontally and the tabs are secured with an M3 screw and nut.

The boards stack together as shown in Fig.4, with 15mm tapped spacers and M3 x 6mm screws. The integral side slots in the case must be cut away for the first 13mm to allow the assembly to slide into place.

Drill a hole in the end of the case for the DC power socket and drill another hole at the other end for the rubber grommet required for the pulse sensor leads.

Use the front panel artwork as a guide to drilling the holes for the switches and to make the display cutout. The cutout is drilled and filed so that the red Perspex or Acrylic window is a tight fit. Attach the front panel label and cut out the holes in this with a sharp knife.

Drill two holes to mount the piezo transducer on the base of the case and drill a central hole for the sound to escape.

The details of the mounting clamp are shown in Fig.5. It attaches to the base of the case with two M3 x 20mm screws and M3 nuts, as shown in Fig.4.

Sensor details

Fig.6 shows how the pulse sensor is made. A section is cut from a 20mm PVC conduit saddle clamp and two slots cut into it install the IR sensors. The IRLED is taken from the IR interrupter assembly by carefully breaking the plastic housing in which the LED is secured. The IR LED is the one which has the diode symbol embossed on the top of the plastic housing. You can break the housing carefully with pliers and side cutters to release the LED.

We do not use the detector within the housing since this is a photo transistor and is not suitable for detecting the small light changes involved.

Cut the saddle clamp as shown in Fig.6 and mark, drill and file the rectangular slots for IRLED1 and IRD1. IRD1 should be able to pass through the hole so it is flush with the inside surface of the saddle clamp. The IRLED is best positioned so the rear face of the package is flush with the outside of the clamp.

We used an eyelet as a cable clamp for the wires and this is attached with

The pulse sensor should be wrapped firmly around your finger, to ensure a reliable pickup. Note that the sensor should go over the fleshy part of the finger, not over the bone as some bonehead has shown here.

a countersunk screw which taps into the PVC material. Wires can be soldered to the IRD1 and IRLED1 leads after passing them through the eyelet crimp end. We used some spaghetti sleeving to protect the wires from the clamp. The leads are then secured in place with a 10mm length of 12.5mm diameter heatshrink tubing.

Testing

Connect the DC plugpack to the socket and check that there is a nominal 5V between pins 5 and 14 of the socket for IC1. There should also be 9V between pins 4 and 11 of IC2. If these voltages are correct, kill the power and insert IC1 into its socket. Make sure it is in the correct way. Apply power again and check that the display lights and the pulse rate LED lights. The pulse LED should flash on and off if you rapidly move your finger onto and off the sensor assembly.

Placing the end of your finger over the sensor should make the pulse LED flash on and off (in time with your pulse) and a plus rate should be shown by the display. You may need to adjust VR1 to obtain sufficient sensitivity or it may need to be turned back for best results. Too much sensitivity can make the display show a higher figure than it should.

You can set the minimum and maximum pulse rates using the graph of Fig.1 as a guide. The timer is set by selecting timer and adjusting the minutes displayed. Setting the timer to 60 will provide a timeout after 1 hour. You cannot set the timer to a value that's less than 1 minute.

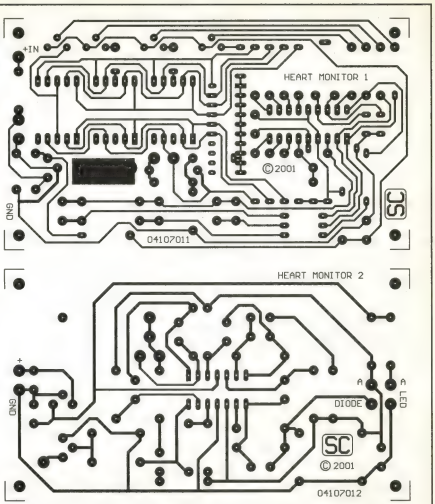


Fig.7: here are the full-size etching patterns for the two PC boards.

When the start switch is pressed, the value in the set timer will be transferred to the timer and it will begin counting down every minute.

The three lower display LEDs in the bargraph should chase each other when the timer is counting down unless your pulse heart beat is above or below the preset maximum and minimum figures.

You will need to make a finger stall with Velcro to hold the pulse sensor securely onto your finger while you exercise. **SC**

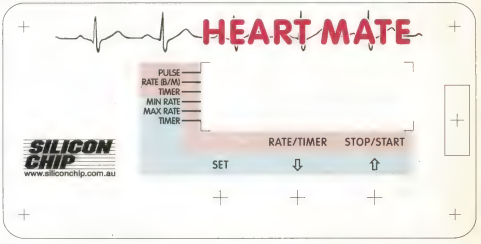


Fig.8: this full-size front panel artwork can be used as a drilling template.

SERVICEMAN'S LOG

The Televideo that committed hari-kari

I've got rather a mixed bag this month, ranging from a Teac Televideo that committed hari-kari – or so my son claimed – to a DVD player that was sunk by U-571. One thing's certain – granny won't be lending her Televideo any more.

Some years ago, I gave my mum a Teac Televideo (MV1440) for her birthday. It was perfect for her little bedroom and she could lie in there and watch her recorded soapies to her heart's content.

Recently, to everyone's surprise and relief, my son actually got a job as a warehouse assistant. This was fine until one day the ancient warehouse roller door decided to jam in the open position.

Unfortunately, the earliest anyone could replace the door was the following week, which meant the warehouse had to be left open to the world. The consternation about security concerns this caused management was enormous until my son, who had just learnt about overtime, put his hand up to become nightwatchman. This appealed no end to the management who eagerly agreed to this arrangement.

My son quickly went home to get some essentials, like a six pack (of light ale) and his Walkman. He also persuaded his granny to lend him her prize Televideo – to get through the wee small hours.

He arrived back at the warehouse, unloaded his van and proceeded to build a little nest in one corner of the warehouse which was in a good position to view the broken garage entrance. The TEAC was placed precisely on top of an old oil drum but unfortunately the reception was lousy with the indoor aerial. Apparently, he was fiddling with the aerial in an attempt to improve the reception when the accident happened.

The way he tells it, it was the set that had deliberately committed hari-kari. The way I saw it, he had pulled the lead too hard and the set fell off the oil drum and landed very heavily on its back on the concrete. He brought it to me the next day, sheepishly pleading: "Please fix Gran's telly . . . and please don't tell her anything".

Well, I took it to the workshop but as soon as I had removed the back, I could see that the set was a write-off. The neck of the tube had broken and the motherboard was cracked. What could I do? I went around to a rival TV repair shop whose main line of business was buying, restoring and selling secondhand TVs.

I'm on good terms with them and so I asked if by any chance they had a Teac MV1440 in stock. We went down into their warehouse and had a rummage. The only thing they had was an MV1480 MK II, which is a later model, but it did have some faults. Apart from being filthy and having the front flap missing, the set worked a bit. There was no sound and a washed-out snowy picture on-air. The video was also working but there was just a snowstorm on playback. However, this all worked to my advantage in the price negotiations.

Back at the workshop, I started with the video playback, which turned out to be very dirty heads. A careful wipe of the heads axially with a lint-free material and oil-free acetone cleaned them thoroughly. The sound fault was more difficult to find but in the end turned out to be an intermittently open-circuit loudspeaker. All I was left with was the snowy off-air pictures.

First, I checked the aerial socket and for continuity to the extremely small Murata tuner. I then checked that the set was able to tune in all the stations on VHF and UHF, which it did – albeit slightly snowy. I then

checked the RF AGC (it was about 6.5V) and found that the AGC control in the separate equally small IF module also worked but adjusting this didn't clear the fault.

Although I had the service manual for this model, the circuit is not drawn for the tuner or IF modules which are just shown as block diagrams. I was faced with a dilemma – was the tuner faulty or was it the IF module or both? I was satisfied that all the voltages into both were correct. The big downer in this progress was that the tuner alone had a trade price exceeding $108 and the IF unit over $172.

To narrow things down, I connected another tuner in place of the original and found that the picture was more or less the same after retuning, which to my mind eliminated the tuner. I then removed the IF module and examined it. It consisted of an IC, several coils and ceramic filters, and several surface-mounted components, including three transistors. I checked the transistors and this revealed that the SAW filter driver (or first IF transistor) was open circuit.

Unfortunately, I didn't know its type number, so I had to try a different approach. I looked through a pile of scrapped TVs and videos, searching for a similar surface-mounted transistor which was performing the same function. I eventually found one in the IF stage of a Hitachi video and swapped them over. And that did it – after retuning and readjusting the AGC control, I could finally tune in perfect pictures.

A bit of "Nifti" cleaner and some polish cleaned the rest of the set up nicely. Finally, I checked that the old remote control worked the newer model which it did.

Granny was surprised to get back a different set but found that the new one gave a better picture. As for my son, he's traded the repair for a few months of lawn mowing and other domestic duties.

A crook Akai VCR

Mr Jones brought in his Akai VS-G425EA video, complaining that it was chewing up his tapes. Unfortunately, he didn't bring in any of his tapes; nor was he clear what he was doing when the tapes got damaged.

Fortunately, I have a large box of ruined tapes for such occasions. I removed the covers, put a tape in and it immediately laced up against the drum and played OK. It could also fast forward and rewind but was intermittently slow in bringing the tape back into the housing. It would also sometimes leave tape loose on top of the deck so that when you pressed eject, the cassette door would close, leaving the tape outside to get all "scrunched" up.

My immediate assumption was that the idler reel was faulty and sticking and not providing sufficient torque to pull the tape in whenever the mechanism unlaced the video heads. I removed the whole deck which is very easy these days – undo five screws and pull three assorted plugs and sockets and it's out (after you have removed the front escutcheon, of course). I removed the reel roller, examined it closely but could find nothing wrong to the eye. I put a new one in just in case and replaced the belt as well.

Items Covered This Month

- Akai VS-G425EA VCR.
- Teac MV1440 Televideo.
- Philips 14GR1224/75R TV set.
- Sony DVP-S735 DVD player.

Unfortunately, they made no difference. The reels were running free, with no hindrance, so the problem had to be elsewhere.

My eye now moved onto the next suspect, the mode select switch. This VCR isn't very old and looks new with little wear. Mr Jones is an old age pensioner but doesn't watch many video movies, so why would you expect trouble with a fully encapsulated rotary switch underneath the deck?

Yeah, well I wish someone would tell me because replacing it fixed the problem completely. In fact, before I did that, I lightly squirted it with CRC 2-26 and that also fixed it. I then opened up the switch to have a good look inside. It looked immaculate, nice and clean with a transparent layer of light switching grease to protect the metal surfaces.

Despite all this, apparently the contacts had gone high resistance, hence its early demise. Cleaning and re-lubricating them will work for a while, but clients demand much more these days!

GRI-AX revisited

Over the years, I have seen many Philips GRI-AX chassis TVs. By and large, they have been an excellent series of models which have performed

well and have been mostly easy to fix – that is, until recently!

Mr Sorensen's 11-year old 14GR1224/75R was dead and he sensibly brought it in because it is a lightweight and it's always easier to bring the set to the workshop rather than vice versa.

The set was slightly corroded inside but consistent with its age, and it didn't take long to work out that the flyback transformer and line output transistor were both cactus. Both were replaced and the set left on soak test for several days before Mr Sorensen came to pick it up.

As is my policy on all TV repairs, if there are any dry joints in the set (and which set doesn't have any?), I set to work and resolder them. The GRI-AX is very prone to dry joints, especially around I7020 and the line output stages, but after a thorough soak test, I was very confident that all would be well.

But it was not to be. Three weeks later he brought it back in, saying it was dead again. I lent him another set and had another go at it. Intermittent problems with this model are invariably due to the SCR crowbar current switching on prematurely. By measuring the voltage across C2660, or more conveniently from the anode of the SCR6641 to ground, which should be 97V, you can then adjust VR3625 until the SCR fires – theoretically at about 101V or so.

If it is less than this, I change zener diode ZD6640 from 30V to 33V, or even higher if necessary, and then repeat the adjustment. When satisfied it is firing at the correct point, I then reset the voltage for 97V or less.

The other thing that should be done is to replace C2523 with a new 10µF capacitor and also replace C2542 and L5524. With all that done, I was feeling bullet-proof but this set only worked for another day before it died again and stayed dead.

I was so glad it had happened in the workshop and not back at Mr Sorensen's house. And I was even happier that it was now permanently dead because this gave me a better chance to nail the problem properly.

I soon found that the remote control could switch the set on from standby, after which the red LED would go out. There would then be a "wimpish" noise from the set as it tried to come on, before ultimately failing.

It was time for some voltage measurements. The full 97V was available right to the collector of the line output transistor (TR7528) but the 9V startup voltage was way down at about 6V. Using an oscilloscope, you could see the correct waveform start to build up all the way from pin 26 of IC7020, through TR7521, TR7523 and TR7528 – but it would always collapse almost immediately.

The set is designed to start with 9V and then have the 12V take over from the flyback transformer via D6542. I had already replaced the flyback transformer (T5530) and the line output transistor (TR7528), so now I fitted a new IC7020 into a freshly soldered 28-pin IC socket. This made absolutely no difference so I then swapped the chassis with one from another nearly identical set that was also in for repair but the main chassis still refused to fire up properly. Grasping at straws, I next desoldered the sound output IC (IC7103), as this is often troublesome and can provide an unacceptable load when the set is attempting to start. This still made no difference.

Finally, I connected an external power supply to the cathode of D6635 and wound it up to 10V before switching the set on. Bingo! – it fired up. I then removed the external power supply and the set remained on. Next, I switched the set to standby and then on again and it still worked. I repeated this many times until suddenly it wouldn't start again unless an external power supply was connected to the 9V start-up rail.

What was going on? My assumption was that this rail was too low for a successful startup sequence but after installing new diodes (D6635 and

D6632) and several new electrolytic capacitors and getting nowhere, I decided to try a different tack. It was time for the hot and cold treatment, so I began by hitting the usual suspects with freezer to see if this would pinpoint the problem

Now, I might add at this point that when the set did start on its own, the 9V rail was actually closer to 10V. It definitely wasn't low, so I couldn't help feeling this was a red herring. Anyway, it was while I was alternately freezing and heating components near the rear of the flyback transformer that I noticed the problem suddenly become more critical – like a doctor or dentist finding a sore spot on your body or mouth.

Anyway, it seemed to me that the culprit was D6624. My circuit showed this to be a 4.3V zener diode but in actuality it was an 1N4148. I then realised I was looking at the wrong circuit diagram because in fact the set was GRI-AX version 2. I replaced the diode anyway and a few others nearby but the trail was becoming cold again.

More soak testing was required before the fault re-occurred two days later and I repeated the hot and cold treatment. By now, I was beginning to realise that if the line drive signal was insufficient on startup, the set would not turn fully on. This might also be due to a lack of gain in transistors TR7521 and TR7523.

I replaced the latter first with a BC547C, the original being a BC337-40, but it made no difference. By now the set was again in one of its "let's play dead" modes. I then replaced TR7521 (a BC368) with another BC547C, making sure that I bent the base lead around the collector lead to fit the leads in the correct holes.

This time the set switched on perfectly. I measured the old transistor to find its collector-emitter junction was very leaky. I was delighted to have at last found a real faulty part and left the set to soak test with repeated on/off switching for the next week before returning it to Mr Sorensen.

Sunk by friendly fire

A good friend of mine is an Australian of German extraction and is a fine technician, working for the local Sony agency. An English client brought his Sony DVP-S735D DVD player in, complaining that the disk drawer wouldn't open. My friend showed him how to open it by pushing a lever underneath to release the drawer. The client did this but when he put the DVD back in, the drawer jammed shut again.

My friend finally booked the unit in and examined it in the workshop. First, he noticed that without a disk in it, the drawer would open and close by itself quite normally and without duress. However, when the DVD was put in, the drawer jammed. The DVD played perfectly and did all the trick functions – it just wouldn't release the disk.

My friend removed the covers from the machine and tried to see what was happening. He could see the disk go in OK, the spindle locking magnets clamp in position and the laser focusing as the disk started to spin. All was fine, until he hit eject. The spindle locking magnets opened but instead of releasing the disk, the DVD was being held by the top magnet and was preventing the door from opening.

It looked as though this particular DVD was magnetic! He tried half a dozen other DVDs and CDs and none of them gave any problem – it was just this particular DVD.

And the name of the movie on this DVD? – it was "U-571". Talk about being sunk by friendly fire!

Now, I thought this was a damn good story – but there is a twist. My friend went home that night after fixing it and thought about it. In the end, he just couldn't believe that the DVD disk could be magnetic – it stretches one's credibility just too far. So the next day he went back to the set and re-examined the facts.

The DVD player could play any other DVD/CD except "U-571". What about trying it in another player? He did that and found that it would play on other machines, thus exploding his original theory – almost every other player uses the same magnetic clutch mechanism. So why wouldn't "U-571" play on the Sony machine?

Very careful examination under a magnifying glass showed there was a very fine film of "gunk" on both the DVD disk and the metal plate it was sticking to. The two surfaces were almost analogous to a 2-part epoxy glue. By cleaning both surfaces very carefully, he was able to then play "U-571" on the Sony machine without it sticking to the magnetic metal plate.

So I guess the answer is obvious – always keep it clean! **SC**

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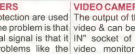

B&W Camera built on a PCB with auto iris. 0.1 lux. Can be focused sharply down to a few mm(useful for people with visual impairment). Spec.: Power req.: 10V to 12V @ approx. 50mA.CCD: 1/3", 30grams: $89, with 92° lens:

SUGAR CUBE CMOS B/W CAMERA: (Reviewed EA Sept. 1999) This (16 x 16 x 15mm) black & white video camera includes a pinhole lens with a field of view of 56 x 42 degrees. Resolution is 240 TV lines (288 x 352 pixels), 1/3" CMOS Image Sensor, 2:1 interlace with a shutter speed of 1/60 to 1/60,000. Other features include auto exposure control, backlight compensation, auto gain control. Has an AGC disable pin which can be tied low for outdoor use. It operates from 5V DC and only draws 10mA: (CAM2) $70

8 CHANNEL PC CONTROLLED RELAY INTERFACE KIT: Ref: Silicon Chip Sept 2000. Operates eight relays from a PC parallel port. Kit inc. PCB & all on-board parts inc. eight relays (2 higher current) with indicating LED's & DB25 connector. Also some simple software on disk. written in Basic to operate the kit: (K164) $40
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"DO NOT DISTURB" TELEPHONE TIMER

Al Bell invented one of the most useful – and one of the most frustrating – communications devices of all time. What do you do when you don't want the 'phone to disturb you?

by JOHN CLARKE

There are times when you simply don't want to be disturbed by anything, let alone a telephone – especially by that incessant "ring ring... ring ring... ring ring..."

Of course, the person at the other end of the line doesn't know that you are, well, umm, let's just say you're otherwise engaged.

But you can imagine such times, can't you?

What do you do? Take the phone off the hook? Sure, that works – until a couple of hours/days later you start to wonder why no-one's ringing you.

What you need is either something to remind you to put the phone handset back on the hook – or better still, do it for you so the process is automatic.

And that is exactly what the SILICON CHIP "Do Not Disturb" Timer does.

Even better, it does it without you lifting the handset in the first place: you simply set the time period you're going to be "busy" – whatever that is – and press the start button. The phone then effectively goes off-hook (ie, anyone ringing will get an engaged signal) until the time period is complete. The phone is then restored to its "normal" (ie, on-hook and waiting for calls) state.

As far as time periods go, you have everything from a sprint to a marathon – 7.5 minutes to a whopping two hours. And if the reason for your not wanting to be disturbed ends prematurely you can hit the "hang up" button at any time.

You can even make the off-hook time period indefinite by not selecting a time period. If that sort of sounds like you're defeating the purpose for making the device in the first place, it's a great little security feature if you don't want anyone else to use the phone while you're away from

This almost-larger-than-life photograph shows the completed project. The leads emerging top and bottom plug into the phone and wall socket. It doesn't matter which way around they go.

PLEASE NOTE

This Telephone Timer is NOT an Austel-approved device. The penalty for using a non-approved device, if detected and subsequent prosecution took place, could be a heavy fine, up to $10,000.

it – especially if the little box is hidden!

Speaking of little box, the timer is housed in a small plastic case with a 6P6C telephone socket located at each end. It has a 4-position DIP switch and two tiny pushbutton switches poking through the box top – one to start the timer and one to stop it manually. A LED indicates when the phone is off-hook.

Installation is simple: you just unplug the telephone line socket from the phone, plug it into the timer, then plug in a modular lead from the timer to the phone.

In case you're feeling a sense of deja-vu, yes, we have described a similar device before – back in July 1992, in fact. But that used an LM3909 timer and alas, those devices are no more. Hence this new, improved model!

How does it work?

When you lift the handset on a telephone, the voltage across the telephone line drops from a nominal 50VDC to around 3-6VDC. The voltage drops because of the load provided by the telephone. The voltage drop (or more accurately the significant increase in current) is detected at the telephone exchange and so the telephone is recognised as being off-hook, in anticipation of receiving either the tones or pulses required to dial a number.

If the phone is simply left off-hook without another number being dialled, the telephone exchange will still recognise the telephone as being off-hook or engaged and prevent incoming calls. After a certain time it will automatically send "engaged" tones to the phone but that is unimportant as far as we are concerned.

The timer works by connecting a load across the telephone line to simulate an off-hook condition. This off-hook condition means that there is a nominal 20-25mA drawn from the line. The timer starts and maintains the off-hook condition until the end of the time period or until the "end" switch is pressed.

At this time it removes the load across the line, fooling the exchange into believing that the handset has been put back on the phone, readying it for a call.

Features

- Start and Finish timer facility
- LED indicator shows off-hook status
- Powered from phone line
- Four time periods plus indefinite

The circuit

The full circuit for the Do-Not-Disturb Timer is shown in Fig.1. It comprises a 4060 counter IC, a 7555 timer IC, a LED, two transistors and a few diodes, capacitors and resistors.

Diodes D1-D4 provide full wave rectification for the telephone lines, necessary since the polarity of the line voltage is indeterminate.

Power for IC1 & IC2 is derived via the rectified telephone line voltage via a 220kΩ resistor feeding zener diode ZD1. This develops a nominal 5.6V across the supply pins of IC1 & IC2, smoothed by the 10µF capacitor.

The trigger input to IC2 (pin 2) is initially held high via the 470kΩ resistor connected to the positive supply rail, while the threshold input (pin 6) is initially held low via the 100kΩ resistor to 0V. This sets the output at pin 3 low.

NPN transistor Q1 is therefore off and so is PNP transistor Q2. The collector of Q1 is held at the rectified

voltage from the phone line via the 2.2kΩ and 1kΩ resistors. This voltage also pulls the reset input of IC1 (pin 12) high via a 1MΩ resistor to reset this counter. Diode D5 prevents this input going above the IC supply rail.

Pressing the start switch (S6) pulls the trigger input of IC2 (pin 2) low, setting the output (pin 3) high. Q1 is then switched on via the 10kΩ base resistor. In turn, transistor Q2 is switched on via the base current flow through the 1kΩ resistor and Q1. Transistor Q2 connects two 180Ω resistors in series across the phone line (via the D1-D4 bridge rectifier) to simulate the off-hook loading.

The voltage across the telephone line now drops to around 6V. Supply is maintained to IC1 and IC2 via diode D10 at the collector of Q2. The indicator LED1 will now be lit via the 1kΩ dropping resistor to indicate the off-hook condition.

At the same time, the IC1 reset (pin 12) is released because of the low voltage at Q1's collector. Components at pins 9, 10 & 11 of IC1 form an oscillator with the internal inverters operating at a nominal 0.88Hz rate.

IC1 is a counter – each of its outputs, Q10, Q12, Q13 and Q14, goes high when the IC counts a certain number of pulses from the oscillator. In the case of Q10, it goes high when the count reaches 512 pulses. So if the oscillator is running at 0.88Hz, the output goes high after about 7.5 minutes.

Similarly, Q12 counts 2048 pulses, or about 30 minutes, Q13 4096, or about 60 minutes and Q14 8192, or about 120 minutes.

In case you were wondering what happened to Q11, 1024 pulses/15 minutes, the answer is that the chip does the count but there are insufficient pins on the IC to bring out all the counter outputs, hence we don't get 15 minutes!

If switch S1 is closed, this high will pull pin 6 of IC2 high to reset it. Pin 3 then goes low, switching off Q1, Q2 and the off-hook loading resistors. As far as the exchange is concerned, the telephone is now back on hook.

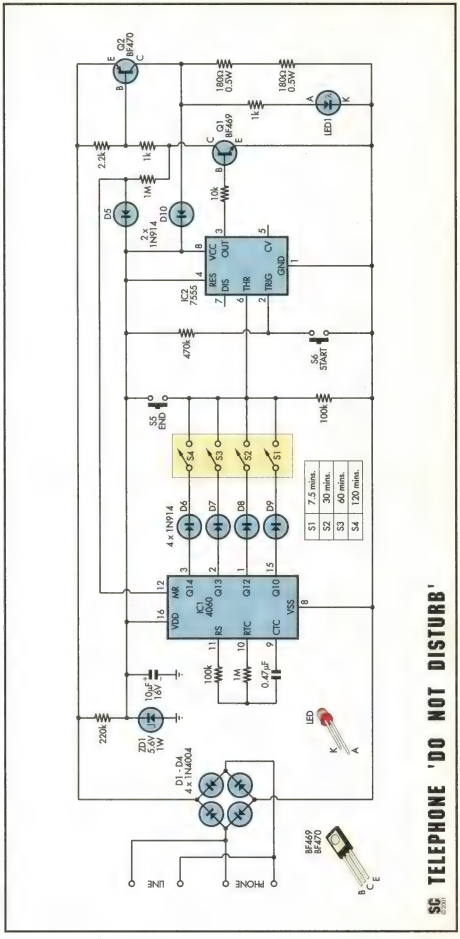
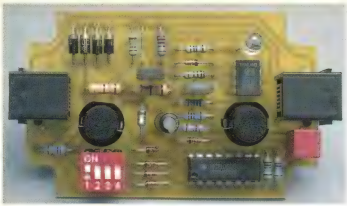
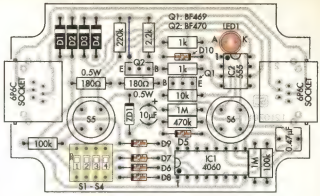


Fig.1 (right): the circuit diagram shows the simplicity of the design: just one counter IC, one timer IC and a handful of other components.





Here's the completed PC board out of its case, with the component overlay (Fig.2, right) printed at the same 1:1 scale. What you cannot see here is the switches and LED mounted high off the board to poke through the front panel.

For longer times, IC1's Q12, Q13 & Q14 outputs can also be selected to give timeout periods of thirty minutes, 1 hour or 2 hours respectively. These are chosen with switches S2-S4 respectively. Note that if more than one switch is closed, it will be the lowest-time switch which will determine the timeout period, since its output will go high first. The others will be ignored.

The "end" switch, S5, can be used to manually (and immediately) end the time period. It pulls IC2's threshold input (pin 6) high regardless of the outputs of IC1, returning the circuit back to "on-hook".

High voltage transistors are specified to minimise the possibility of breakdown when the phone rings. The ring voltage can be 100Vp-p above the 50VDC line voltage. These transistors are rated at 250V, which will be adequate for preventing breakdown.

The terminals for the incoming phone line are labelled as the tip and ring. These names are a throwback to the days when phones actually used 6.5mm phone plugs – the names are used these days to label which of the two wires is nominally "hot".

The two sockets are paralleled, allowing a phone connected to the socket to directly plug into the line, as if the timer were not there.

Because the Timer takes the miniscule amount of power it needs from the telephone line, no battery or other supply is required. This makes it extremely safe.

Construction

All components for the Timer mount on a PC board coded 12107011 and measuring 50 x 79mm. It all fits inside a plastic case which measures 83 x 54 x 31mm. A 50 x 77mm label is glued to the top of the case.

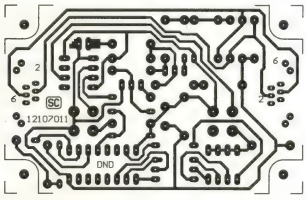
Begin construction by checking the PC board for shorts and possible breaks in the copper tracks. The four corners of the PC board need to be cut to shape to clear the integral pillars in the case. The outline is shown on the copper side of the PC board.

You will also need to drill holes for the integral mounting pins on the 6P6C sockets so that they clip in correctly to the PC board. The Altronics type of socket differs slightly to the one sold by Jaycar and so we have provided both hole positions for the mounting pins.

The plastic case has integral side clips which will need to be removed with a sharp knife or chisel so that the PC board will slide into the case. Check that the PC board fits into the case without fouling.

Insert the resistors in the appropriate place in the PC board using the accompanying resistor colour code table to select the right values. Alternatively, you can use a multimeter to measure the values directly.

As the diodes are inserted, make sure the orientation is correct; likewise the transistors, LED, ICs and elec-



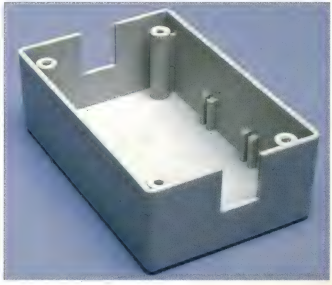
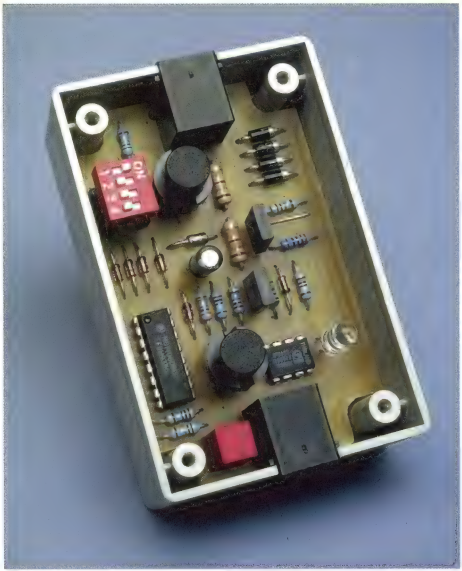


Fig.3: same-size artwork for the PC board. At right is the empty case, clearly showing the cutouts required for the phone sockets and the "surgery" done to the internal guides.



And here's how it all goes together inside the case. There's not much room to spare; in fact you'll have to cut the corners off the PC board to allow it to fit around the corner pillars in the box. The case side guides also need to be removed.

trolytic capacitors are also polarised. Note that Q1 and Q2 are oriented differently to each other.

The electrolytic capacitor requires positioning with the positive lead where indicated. LED1 mounts with its top dome 19mm above the PC board, oriented with the cathode toward the edge of the PC board.

The 6P6C sockets can be installed now, followed by the switches. Switches S5 & S6 must be oriented with the "flat" as shown.

To be at the correct height, these are mounted on top of PC stakes which are cut down so that the top of the switch is 18mm above the PC board. Switches S1-S4 are mounted on a 2 x 4-way pin header so that its height is sufficient to protrude through the front panel.

Place the PC board assembly in position over the case and mark out the cutout positions for the sockets. We cut the box with a fine toothed hacksaw and broke off the piece with pliers. The cutout then was filed to shape. Only cut the hole to the depth of the socket on each end of the box. Test the PC board for fit into the case and adjust any of the cutout sides accordingly.

The lid will require a hole for the LED, the two switches and the DIP switch. Use the front panel label as a guide to positioning these. Also the flanges on the lid directly above the sockets will need to be filed flat so that the lid will sit flush on the case.

Glue the front panel label to the case and cut out the holes with a sharp knife.

Testing

Connect the telephone to one socket using a 6P2C (or 6P4C or 6P6C) extension lead and the telephone line into the other socket.

You can test the unit by pressing the start switch and checking that the LED lights. You can also measure the voltage between pins 16 & 8 of IC1 and pins 4 and 1 of IC2. This voltage should be around 5.6V as set by ZD1.

Press the finish switch to check

Parts List – "Do Not Disturb" Timer

1 PC board coded 12107011, 50 x 79mm
1 panel label, 50 x 77mm
1 plastic case, 83 x 54 x 31mm
1 4-way DIP switch (S1-S4)
2 snap action PC board momentary closed switches (S5,S6)
2 4-way pin header
8 PC stakes
2 6P6C PC board mounting modular sockets
1 6P2C (or 6P4C or 6P6C) extension lead

Semiconductors
1 5mm high brightness red LED (LED1)
1 4060 binary counter (IC1)
1 7555 timer (IC2)
1 BF469 NPN high voltage transistor (Q1)
1 BF470 PNP high voltage transistor (Q2)
4 1N4004 1A 400V diodes (D1-D4)
6 1N4148, 1N914 switching diodes (D5-D10)
1 5.6V 1W zener diode (ZD1)

Capacitors
1 10µF 16VW PC electrolytic
1 0.47µF MKT polyester (code 474 or 470n)

Resistors (0.25W 1%)

2 1MΩ	1 470kΩ
1 220kΩ	2 100kΩ
1 10kΩ	1 2.2kΩ
2 1kΩ	2 180Ω 0.5W

that the LED goes off. Set the DIP switch to 7.5 minutes and press start again and check that the LED goes out after about 7-8 minutes. The time is only nominal and will vary depending on component tolerances and the particular 4060 IC.

You can make the time periods shorter by changing the 0.47µF capacitor to a smaller value. Longer time periods can be achieved by changing the 0.47µF capacitor to a larger value. A bipolar electrolytic capacitor can be used in place of the MKT type but do not use a standard polarised electrolytic.

A final check can be made by lifting the telephone handset and listening for the dial tone. This tone should last for about eight seconds, after which the tone will change to an engaged signal.

Now try this with the handset back in place. Press the start switch on the timer and wait for, say, 10-15 seconds. Lift the telephone handset and check if there is engaged signal.

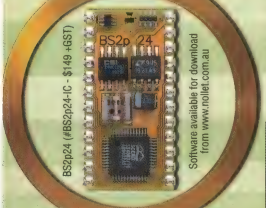
If it is engaged you can be sure that the timer has caused the telephone to be off hook. **SC**

Fig.4: 1:1 artwork for the front panel. Use a photocopy as a template to drill the holes required. (This panel and the PC board artwork can also be downloaded from the SILICON CHIP website: www.siliconchip. com.au).

RESISTOR COLOUR CODES

No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑ 2	1MΩ	brown black green brown	brown black black yellow brown
❑ 1	470kΩ	yellow violet yellow brown	yellow violet black orange brown
❑ 1	220kΩ	red red yellow brown	red red black orange brown
❑ 2	100kΩ	brown black yellow brown	brown black black orange brown
❑ 1	10kΩ	brown black orange brown	brown black black red brown
❑ 1	2.2kΩ	red red red brown	red red black brown brown
❑ 2	1kΩ	brown black red brown	brown black black brown brown
❑ 2	180Ω	brown grey brown brown	brown grey black black brown

GOLD MEDAL STAMP



BASIC Stamp 2p provides easy interface to I²C, LCDs and Dallas Semiconductor iButton parts. Writing assembly language code to interface your microcontroller to I²C, 1-wire and parallel LCDs can be tedious. If time matters and you want to get the job done try the BS2p - it executes one-line tokenized BASIC commands for each of these parts. Shift registers, serial communication and parallel I/O control also boil down to a few lines of code. The following PBASIC example writes a byte of data (100) to location five of a Microchip 24LC32 EEPROM on I/O pins 0 and 1.

```
I2COUT 0, $A0, 5, [100]
```

Package	24-pin or 40-pin DIP
Environment	32-158 C
RAM / EEPROM	38 bytes / 16K bytes
Voltage Req.	5-9 VDC
Current Draw @ 5V	40 mA run and 400 uA sleep
PBASIC commands	55
Programming Req.	Serial cable and a PC (no hardware tools required)

web: www.nollet.com.au
email: ron@nollet.com.au
ph/fax: (03) 9338-3306

Easy interface to I²C, LCDs and Dallas Semiconductor iButton parts.

Jaycar ELECTRONICS JULY SALE

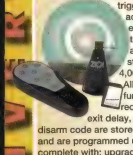
Prices valid to end July 2001

As easy as ordering a pizza! TECH Assistance WWW.JAYCAR.COM.AU 1800 022 888

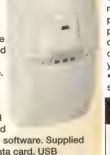
OVERNIGHT DELIVERY

CROW MEMOCAM NEW

Replaces the usual Camera / PIR / Time Lapse VCR surveillance system.



Features include external trigger, 2 relays for activation of external devices, a tamper switch, time and date stamp and storage of up to 4,000 images at once. All settings and functions including recording time, entry exit delay, time and date and disarm code are stored on the MMC card and are programmed using the included software. Supplied complete with: upgraded 16Mb MMC data card, USB multimedia card reader, full function IR remote control, 12VDC PSU, mounting bracket, software and drivers.



Min system requirements: Pentium II 200Mhz, 16Mb RAM, 640 x 480, 16 bit res, Win98 with USB support.

Cat. QC-3010 **$1,699**

AMAZING AMPLIFIED SUBWOOFER DEAL NEW

ATTENTION HOBBYISTS & AUDIO FANS

We have a quantity of 80pcs of a 6.5" subwoofer in a bass-reflex enclosure with a 60WRMS amplifier. This unit formed the basis of the AC-3 Home Theatre System we sold last year. The input socket is an odd mini-DIN connector. We do not have the plug for this so in order to use the unit you will need to get your soldering iron out and solder the input wires directly to the amplifier module PCB in the enclosure. It is a bit of mucking around, but this is reflected in the low price of the unit. Again we stress that you cannot simply buy this, take it home, and plug it in. We include a wiring diagram for identification of the relevant connection points on the rear of the 9-PIN plug for the line-level inputs. See our '00 catalogue page 79 for the complete Home Theatre System. The cabinet's size is approx. 190(W) x 360(H) x 320(D) mm and the unit can be used for a small Home Theatre System, up market computer sound system or small Hi-Fi system, etc. Unit operates on 240VAC. Cat CS-2460

Only $75
3+ **$67.50**

'OFF-HOOK' TIMER KIT FOR PHONE LINES NEW

Refer: S.C. magazine July 2001

This off-hook timer prevents the phone ringing for a set period of time, then will automatically restore the phone back on-hook. 4 time periods (7.5, 30, 60 & 120 minutes), and is powered by the phone line. Kit supplied with silk-screened case (83 x 54 x 31), PCB, phone sockets, phone lead and all electronic components. Note: As this is a DIY kit it is not ACA Appoved. Cat. KC-5314 **$24.95**

RETRACTABLE EXTENSION LEAD RJ12 TO RJ12 NEW

Automatic retracting cable suitable for modems and laptops. Ideal for portable networking. Four conductors. Length 2.5 metres. Cat. YT-6050 **$29.95**

FANTASTIC CAR SUPER TWEETER DEAL NEW

We have made an amazing scoop purchase of a quantity of Car Super Tweeters. They have a large magnet assembly, on board crossover capacitor and are pre wired for easy connection. These are supplied as pictured, with a foam gasket on the front, (which is easily removed). There is no other mounting hardware supplied, but at the price, who cares! Mount them anywhere with double sided tape, or in vents, A pillars, rear pillars, or anywhere where you need more treble. •System power: 40WRMS •Freq Resp: 6-20KHz •25mm Mylar Dome tweeter. These sound just as good as our $55 pr super tweeters. We would expect these to sell for around $25 each.

$7.95ea
10+ **$6.50ea**
100+ **$5.50ea**
Cat CS-2218

JAYCAR COMPUTER COOLING FANS

INTERNAL HARD DISK DRIVE COOLER NEW

Extend your hard disk drive life and reliability with this highly efficient single fan cooling system. This cooler mounts directly on top of the drive blowing a constant stream of cool air directly onto the PCB.

Cat. XC-5043 **$22.95**

3D COOLING FAN AND HEATSINK NEW

FOR GRAPHICS PROCESSING UNIT

This GPU cooling fans features a 50mm fan with tacho output mounted on a super efficient spiral type anodised heatsink. Designed to cool graphics processing units such as the 3DFX and NV20. Connects to GPU via dual 'through hole' mounts and a temperature resistant adhesive pad for easy installation. Total dimensions 54.2(Dia.) x 20.5(H)mm. Cat. XC-5031 **$33.95**

PENTIUM 4 CPU COOLING SYSTEM NEW

Uses a 60mm fan with tacho output. Supplied complete with heat transfer compound for optimum efficiency. Mounts to CPU via solid metal Willamette type socket and adhesive heat transfer compound. •89(L) x 61.5(W) x 60(H)mm. Cat. XC-5038 **$42.95**

COOLING FAN AND HEATSINK NEW

FOR GRAPHICS PROCESSING UNIT

Extend the life and reliability of your graphics processor. This cooling fan and heatsink are designed for cooling graphics processing units such as the 3DFX and NV20. Unit utilizes a 40mm fan with tacho output and features dual 'through hole' mounts and a temperature resistant adhesive pad for easy installation. Cat. XC-5030 **$14.95**

3 FAN HARD DRIVE COOLING SYSTEM NEW

Similar to our existing twin fan unit. This unit installs into any vacant 5.25" drive slot and can dramatically improve the airflow around the hard drive. Low noise, long life fans. Cat. XC-5044 **$34.95**

PENTIUM 3 CPU COOLING SYSTEM NEW

This Pentium 3 processor cooling system features a quality 50mm ball raced fan with tacho output and high efficiency spiral type heatsink. Mounts to CPU via solid metal clip and adhesive heat transfer compound. Total dimension 65(Dia.) x 40(H)mm. Cat. XC-5036 **$29.95**

50MM 12VDC FAN BARGAIN Limited quantity

•Brushless fans •50mm square x 10mm thick. •Current draw is 130mA. •2 wire input. Cat. XC-5056 **Only $12ea**

COLOUR CDR MAKER PENS 4 PACK NEW

Specially designed permanent markers for labeling CDR's. Colours include Black, Green, Blue and Red. Cat. TM-3040 **$9.95**

ATX MINI TOWER CASE NEW

This mini tower case features a 250W Switchmode power supply. It boasts 3 x 5.25" and 2 x 3.5" floppy disk bays as well as 7 rear peripheral slots. Measures 200Wx430Dx 340Hmm Cat. XC-4635 **$79.50**

OVERNIGHT DELIVERY

5Mhz HANDHELD STORAGE OSCILLOSCOPE

SAVE $20

See catalogue page 33 for details. This clever little device puts the functions of a digital votmeter and a 5Mhz CRO in the palm of your hand. Allows a sample of a waveform to be captured and stored for later analisis on a PC. Features a high 20Mhz sampling rate and is supplied with software to suit MS-DOS, WIN3.1, WIN95, and WIN 98. Cat. QC-1907

WAS $279 **July $259**

Jaycar will match or better the price of any product our competitors sell, provided the goods are in stock, and of the same quality. Sale Prices Included.

Super Bright LED Keyring Torches

NEW

These little gadgets are so good that everyone in the office bought one! They use a high brightness LED and draw very little power, but produce an amazing amount of light for their size.

ST-3046 Yellow **$9.95** ST-3047 Blue **$14.95**
ST-3048 White **$14.95** ST-3049 Green **$14.95**

Plasma Tube

NEW

LIGHTNING IN A TUBE! This decorative lamp emits a multitude of ever changing, bluish-purple lightning bolts from the centre to the side. When you touch the glass the lightning is attracted to your fingers. The lamp features an on board microphone which can be used to make the lamp respond to voice and/or music. The plasma tube is 60mm in diameter and stands 150mm tall. Mains to 12VDC power adaptor included. Cat. SL-2971

$99

Super Bright 3 LED "White" Torch

NEW

This headlight torch is fantastic! It weighs just 62 grams (with batteries) and uses 3 ultra-bright LEDs to give an amazing amount of bright, nicely diffused white light. A tough, 360 degree swivel ball mount clip attaches to the elastic head strap or it can be clipped to your belt, baseball cap, wristwatch strap. LEDs require much less power than ordinary globe and will run for ages on the 3 x AAA batteries (included).

Cat. No. ST-3058 **Only $29.95**
1 LED VERSION AVAIL. Cat. ST-3057 $19.95

NEW DIGITAL MULTIMETERS

30 RANGE DMM

See cat. P28 for full specs.
Features include:
•Probe Lockout •Shutters •Backlight •Temperature •Capacitance •Extra Large Display •Data Hold •Continuity Buzzer •Holster Included •Low Battery Indicator
Cat. QM-1301

$69.95

FREQUENCY DMM

See cat. P29 for full specs.
Features Include:
•Probe Lockout Shutters •Backlight, •Temperature •Capacitance •Frequency •Extra Large Display •Data Hold•Continuity Buzzer •Holster Included •Low •Battery Indicator
Cat. QM-1321 **$85**

AUTORANGING DMM

Features Include:
•Probe Lockout Shutters •Slow Decay Backlight •Auto Ranging •Capacitance •Frequency •38 segment •Bargraph •3999 Count •Clamp Meter Range •Data Hold •Continuity Buzzer•Holster •Low Battery Indicator
Cat. QM-1532

$79.95 SAVE $20

DOUBLE INSULATED AUTO RANGING DMM

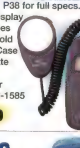
See cat. P29 for full specs.
Feature Include:
•3.75 Digit •Slow Decay Backlight •Frequency •Auto Power Off •Continuity Buzzer •Relative Measurement •3999 Count •Capacitance •Auto Ranging •Data Hold •Low Battery Indicator •Duty Cycle Measurement
Cat. QM-1540 **$89.95**

AC/DC CLAMP METER DMM

See cat. P32 for full specs.
•200A AC/DC •Frequency •Capacitance •Auto Ranging •Auto Power Off •Data Hold •One Touch Zero Function •Duty Cycle Measurement •Continuity Buzzer •Carry Case Included •4000 Count
Cat. QM-1562 **$159**

DIGITAL LUXMETER

See cat. P38 for full specs.
•LCD Display •3 Ranges •Data Hold •Carry Case •Seperate Photo Detector
Cat. QM-1585



$99

3.75 Digit, True RMS, PC Connect Bench Multimeter

•RS-232 Interface •Auto Ranging •Capacitance •Frequency •Analogue Bar Graph •Max/Min •Data Hold •Diode Test.
Cat. QM-1240

Was $329 **July $279** SAVE $50

20 RANGE DMM

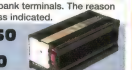
Ranges include:
•Sound Pressure Level •Light •Humidity •Temperature •Transistor Tester
*Continuity Buzzer See cat P30 for details. Cat. QM-1580

WAS $109 **Now $89** SAVE $20

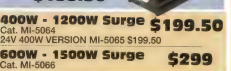
FANTASTIC NEW RANGE OF ELECTRICALLY ISOLATED INVERTERS

Isolated inverters means that they have dielectric insulation between the 12VDC primary and the high voltage (AC) secondary. This means that there is no path for the 240VAC to appear at the battery bank terminals. The reason for this, of course is safety! All 12VDC input unless indicated.

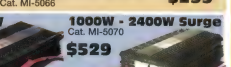
140W - 450W Surge Cat. MI-5060 **$109.50**
300W - 900W Surge Cat. MI-5062 **$159.50**



400W - 1200W Surge Cat. MI-5064 **$199.50**
24V 400W VERSION MI-5065 $199.50
600W - 1500W Surge Cat. MI-5066 **$299**



800W - 2000W Surge Cat. MI-5068 **$389**
1000W - 2400W Surge Cat. MI-5070 **$529**



1500W - 3000W Surge Cat. MI-5072 **$749**

SAVE

SENNHEISER HD56 HEADPHONES

NEW

These high quality mini headphones are the perfect way to upgrade those tinny sounding ear-bud style types that come with many types of portable audio gear. They offer very good sound quality that rivals many larger type headphones and an adjustable headband for a good fit. Supplied with 1.2m of OFC cable terminated with a 3.5mm stereo plug and 6.5mm adaptor. •Freq resp: 20 - 20000Hz •32Ω •Dynamic open back. Cat. AA-2040 **$49.95**

SENNHEISER HD433 HEADPHONES

NEW

These headphones offer true Hi Fi performance for a reasonable price. They are an open back style with "Supra-aural" type ear pads meaning that they sit on the ear rather than around or in them for greater long term comfort in hot weather and more open sound quality with none of the "boxed-in" quality of closed back style 'phones. Their low 32 ohm impedance makes them easy to drive to high levels, even from portable CD players etc. They come supplied with 3m of OFC cable terminated with a 3.5mm stereo plug and 6.5mm adaptor. Come into any of our stores for a demo.
•Freq. Resp: 20Hz-20kHz •Impedance: 32Ω •Transducer: Dynamic open back. Cat. AA-2042 **$79.95**

OVERNIGHT DELIVERY

SURVEILLANCE/ALARM SAVINGS!

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

16 CHANNEL FULL DUPLEX
SAVE $100

COLOUR MULTIPLEXER
See cat P196 for details.
Cat. QC-3365 WAS $2,799
Now $2,699

SURVEILLANCE PANNING / TILT EQUIPMENT
Save 10% on these for July.
Buy 1 unit at the 2 unit price break.
See Cat. page 195 for full details.

Panning Camera Base
SAVE $20
Was $199 July $179
Cat. QC-3206

Pan / Tilt Camera Mount
SAVE $50
Was $499 July $449
Cat. QC-3204

Pan / Tilt Controller
Suits both units shown.
SAVE $20
Was $99 July $79
Cat. QC-3202

2.4Ghz MONITORING SYSTEM
This system has a wireless range of up to 100 metres. See cat P197 for details.
SAVE $30
Cat. QC-3450
WAS $359 Now $329

4 CHANNEL B/W DIGITAL VIDEO PROCESSOR
SAVE $36
See cat page 196 for details.
Cat. QC-3360
WAS $375 Now $339

4 CHANNEL COLOUR DIGITAL VIDEO PROCESSOR
SAVE $40
See cat P196 for details.
Cat. QC-3364
WAS $629 Now $589

COLOUR CCD CAMERA WITH AUDIO
See catalogue page 193 for details.
SAVE $10
Cat. QC-3483
WAS $225 Now $215

B/W PCB CCD CAMERA WITH AUDIO
See cat P191 for more.
SAVE $16
Cat. QC-3462
WAS $115 Now $99

B/W DOME STYLE CCD CAMERA
See catalogue page 191 for details.
Cat. QC-3472
WAS $119 Now $105
SAVE $14

DOME STYLE COLOUR CCD CAMERA
See catalogue page 193 for details.
SAVE $19
Cat. QC-3484
WAS $249 Now $230

PINHOLE CCD CAMERA WITH AUDIO COLOUR
See catalogue page 193 for details.
SAVE $10
Cat. QC-3486
WAS $225 Now $215

BULLET STYLE CCD's
SAVE $20ea
See cat P192/193 for details.
Colour Cat. QC-3488 With Panasonic sensor **Now $309**
B&W Cat. QC-3467 **Now $149**

12" B/W SECURITY MONITOR WITH AUDIO AND CHANNEL SWITCHER
This 12" black and white monitor will except up to 4 camera inputs and has the ability to switch between them sequentially at intervals of up to 10 seconds. The monitor also features an alarm trigger record feature controlling the both the monitor and VCR output. See cat P199 for details. Cat. QM-3405
$399

BLACK & WHITE CMOS SURVEILLANCE SYSTEM
WITH 5" MONITOR AND TWO WAY AUDIO
Features Infra-red illumination and case. Identify callers at the front door or be monitoring sleeping children. The system can be operated from 12VDC or rechargeable batteries if required. See cat P197 for details. Cat. QC-3308
$179.95 SAVE $20 **WAS $199.95**

B&W LOW COST QUAD PROCESSOR
This processor features twin outputs and is designed to drive both a monitor and a VCR for recording purposes.
See cat P196 for details. Cat. QC-3361
$259

B&W CCD CAMERA WITH IR ILLUMINATION
NEW
Integrating an infrared spotlight, this camera gives excellent coverage right down to 0 Lux! See catalogue page 191 for details.
Cat. QC-3468
$109

HI-RES COLOUR PRO DOME CCD CAMERA
NOT AVAILABLE FROM DEALERS LTD QTY AVAILABLE
Features a Panasonic photo sensor.
SAVE $60
Cat. QC-3487 **WAS $259 $199**

DUMMY DOME CAMERA WITH CABLES
Ideal as a cost effective theft deterrent. See cat P176 for details. Cat. LA-5314
SAVE $10 **WAS $29.95 July $19.95**

12VDC RED SIREN / STROBE
SAVE $15
See .00 catalogue page 285 for details.
Cat. LA-5310
WAS $29.95
1/2 PRICE **$14.95**

DIGITAL ACCESS PANEL & CONTROLLER
Unit can control our (LA5078) Door Strike and provides keyless entry and extended protection to the property protected. See cat P175 for details. Cat. LA-5350
WAS $129.50 Now $109.50
SAVE $20

Melcom 6500 8 Sector Budget Alarm System
Includes:
- 1 x 8 sector Melcom keypad alarm
- 2 x Micron pulse count PIRs
- 1 x Mains power supply
- 1 x 1.3Ah backup battery

$329

- 2 x Reed / magnet switches
- 1 x Siren horn
- 60 Metres of 4 core alarm cable
- 2 x Stickers Cat. LA-5445

Melcom 6500 8 Sector Comprehensive Alarm System
Includes:
- 1 x 8 sector Melcom keypad alarm
- 3 x Micron pulse count PIRs
- 1 x Mains power supply
- 1 x 1.3Ah backup battery

$429

- 1 x Strobe warning light
- 1 x Siren cover
- 3 x Reed / magnet switches
- 1 x Siren horn • 1 x Internal siren • 100 Metres of 6 core alarm cable
- 2 x Alarm stickers Cat. LA-5447

ATTENTION! ALARM AND SECURITY SYSTEM INSTALLERS
Contact our Wholesale Dept for huge savings on quantity purchases.

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

OVERNIGHT DELIVERY

OVERNIGHT DELIVERY

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

ELECTRONICS TEST BENCH BOOK BARGAIN

HALF PRICE From Silicon Chip. Contains Plans and Instructions for a selection of the best test equipment kits from Silicon Chip magazine. Includes details to build 18 projects. See catalogue P296.
Cat BS-5070 **Normally $10.95**

Now $4.95 or FREE WITH ANY JAYCAR KIT PURCHASED OVER $30

ORTOFON MAGNETIC PHONO CARTRIDGE

NEW

Great new OMB5 cartridge from ORTOFON of Denmark. Features standard 19mm (1/2") mounting centres to fit all tonearms/headshells. This stylus is a quality elliptical diamond for long life & low record wear that tracks at 1.5 - 2.0 grams. Offers unprecedented sound quality for the price. Not suitable for DJ scratching use. Cat. AM-4020

Only $45

PLUG PACK DEALS

9VDC 850MA

TERMINATES TO 1.75MM ID DC PLUG Cat. MP-3009

Normally $14.95ea. **Now $9.95** SAVE $5
Buy 5+ $8.75ea
Buy 10+ $7.75ea

10VDC 850MA

TERMINATES TO 2.1MM DC PLUG Cat. MP-3005

Normally $16.95ea **Now $11.95** SAVE $5
Buy 5+ $9.95ea
Buy 10+ $8.95ea

WIRELESS DOORBELL WITH STROBE LIGHT

Separate door switch and bell allows allows you to monitor more than one door. Ideal for deaf See cat P269 for details.
Cat. LA-5015 **WAS $59.95** **July $49.95** SAVE $10

DOOR BUTTON TO SUIT
Cat. LA-5016 SAVE $5
WAS $24.95 **July $19.95**

SPARE REMOTE CONTROLS FOR OUR OLD MINI HOME ALARM SYSTEMS

Have your got one of our old self contained Mini Alarms? We have spare remotes at silly prices. Grab a spare! See '99 catalogue pages 88 & 86 respectively.

SUITS LA-5142 SAVE $9
Cat. LA-5143
WAS $17.95 **July $8.95**

SUITS LA-5152 SAVE $5
Cat. LA-5153
WAS $14.95 **July $9.95**

POWER SUPPLY BARGAIN

SAVE $$$

We have a quantity of what should be a 12VDC 2 AMP Regulated Power Supply. These units give an output voltage of about 13.0VDC unloaded, and about 12.4VDC with a load at about 1.6AMPS current. Ideal for parts, for hobbyists or for experimentors. Limited quantity - Be quick. Cat. MP-3023

Were $52.95 **These are $15 each**
Buy 5+ $12ea.

Introductory Special on Garden Lighting Transformers

NEW

See catalogue page 255 for details.

12VAC 20W INDOOR
Cat. MP-3041 SAVE $3 **July $9.95**
WAS $12.95

12VAC 105W INDOOR
Cat. MP-3043 SAVE $7 **July $32.95**
WAS $39.95

12VAC 150W INDOOR
Cat. MP-3044 SAVE $10 **July $39.95**
WAS $49.95

24VAC 150W INDOOR
Cat. MP-3045 SAVE $10 **July $39.95**
WAS $49.95

12VAC 150W OUTDOOR
Cat. MP-3048 SAVE $15 **July $54.95**
WAS $69.95

24VAC 150W OUTDOOR
Cat. MP-3049 SAVE $15 **July $54.95**
WAS $69.95

30 Amp Car Battery Clip Bargains

Our suppliers sent a batch that look different to our standard ones. We have 500 pairs available & 2,500 Red only.

Normally sell for $3.65Pr
Red Clip Only $1 Cat. HM-3005
Buy 20 $0.75 ea. Buy 100 $0.60 ea.
Red/Black Pair $2.75
Buy 10 Pair $2.25 Pair Cat. HM-3006

SAVE ON MAINS EXTENSION LEADS

		WAS	NOW
2 Metres	Cat. PS-4122	$3.99	$2.99
3 Metres	Cat. PS-4125	$4.95	$3.95

AMPHENOL 4 PIN CANNON CONNECTORS

Cat. PP-1040 4 PIN LINE MALE **$8.50**
Cat. PP-1044 4 PIN CHASSIS MALE **$13.50**
Cat. PS-1042 4 PIN LINE FEMALE **$8.50**
Cat. PS-1046 4 PIN CHASSIS FEMALE **$8.50**

PARTY LIGHTING

MILLENIUM MUSICAL LIGHT CHASER

SAVE $20

See catalogue page 252 for details. Perfect for DJ's or your next Party, this effects unit features audio muduation input as well as an onboard microphone, variable sensitivity control and a full function remote control.
Cat. SL-2948 **WAS $149** **July $129**

COMPACT FLOURO BLACK LIGHTS

15 Watt
2 Volt, equivalent to a 70W standard globe. Cat. SL-3154
$23.95

26 Watt
3 Volt, equivalent to a 120W standard globe. Cat. SL-3156
$32.95

7EW ULTRAVIOLET SPOTLIGHTS

SAVE $3 IN July
ES BASE NEW BC BASE NORMALLY $14.95EA
Cat. SL-2761 Cat. SL-2763
July Only $11.95 Each

ROTATING PARTY DOME LIGHTS

See catalogue page 253 for details.
BLUE - Cat. SL-2987
RED - Cat. SL-2986
WAS $49.95 **July $42.95** SAVE $7

SPECIAL OFFER - BUY BOTH ROTATING DOME LIGHTS THIS MONTH FOR ONLY $79 SAVE $20.90

240VAC PAR30 CAN LIGHT

NEW

This compact spotlight uses a Par30 100Watt Halogen globe, which produces a whiter and 40% brighter light as opposed to incandescing globe. Globe sold separately - use our Cat. SL-2973.
See Cat. P251. Cat. SL-2972

$45

24V ELECTRIC DOOR STRIKE RELEASE

Unlock your front door with the push of a button. Unit is totally'fail-safe'. See cat P175. Cat. LA-5080

SAVE $15
WAS $49.95 **July $34.95**

18 Pin PIC ZIF Socket

Cat. PI-6480

NEW

$19.95

2 WAY FLAT OFC SPEAKER CABLE

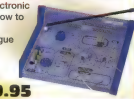
See catalogue page 142 for full specifications.
Cat. WB-1740

NEW

$2.95 Metre **100 Mtr. Roll $225**

AM/FM RADIO EXPERIMENTER'S KIT

SAVE $10



This intermediate electronic educator kit shows how to built an AM/FM receiver. See catalogue page 20 for details.
Cat. KJ-7048
WAS $39.95 **July $29.95**

2001 CATALOGUE OUT NOW

308 PAGES FULL COLOUR
Only $5 including postage. Call now.

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

OVERNIGHT DELIVERY

FULL FEATURE EQUATOR 260 CAR ALARM

NEW

This car alarm has everything that you could possibly ask for. Unit now features new tiny keyring remotes. See cat P182 for more. What you get: *Electronic module *2 Transmitter key fobs *Ignition cut out relay *Shock Sensor *Wiring loom *Mini siren with Backup battery Cat. LA-8985

$199

ULTRASONIC DETECTOR

NEW

This universal ultrasonic produces a negative trigger with a pulse width of 0.2 seconds, which is standard for most alarms. Connects with main unit via 200mm fly leads. See cat P182 for details. Cat. LA-8907

$49.95

FULL FUNCTION CAR ALARM WITH REMOTE PAGER

NEW

All the features of our standard alarm, but with a pager. The alarm can send a message to your key fob remote. If the alarm is suitably wired, you can command the alarm to sound the siren, flash the lights and kill the engine. Here is what you get: •Blackbox electronic module •2 transmitter key fobs •Ignition cut out relay •Shock sensor • Wiring • Mini Size Siren •Backup battery •See catalogue P183 for details. Cat. LA-8960

EQUATOR

$399.50

SHADOW CAR IMMOBILISER

This new microprocessor controlled car immobiliser has passed the latest Australian and New Zealand standards approval. See cat P181 for specs. Cat. LA-8970

$129.50

SHADOW

SPARE REMOTE CONTROL Cat. LA-8972 $39.50

NEW

ALARM SYSTEM UPGRADE FOR SHADOW CAR IMMOBILISER

NEW

This pack converts our new Shadow car immobiliser into a full function car alarm. Features a 20-Watt siren with battery back up, a shock sensor, and bonnet switch. Cat. LA-8975

SHADOW

$79.50

Cigarette Lighter Power Lead

NEW

This quality 5 metre lead is fitted with a car cigarette lighter plug fused at 8A. Cat. PP-1998

$9.95

Low Loss 75Ω Splitter

This signal splitter suits 75 ohm coaxial cable and features screw connections. Suits VHF, UHF & FM signals. See cat P189. Cat. LT-3012

WAS $8.95

$4.45

RJ45 Boots

See catalogue page 154 for details. Pkt 50 Grey

WAS $13.50

SAVE $5

Cat. PM-1444 **$8.50**

5M XLR LEAD (male to male)

SAVE $5

This lead features an XLR plug to XLR plug and uses quality 2-core 6mm microphone cable. See cat P147 for details. Cat. WQ-7270

WAS $17.95 July **$12.95**

LCD COUNTDOWN TIMER WITH TRIGGER

HALF PRICE

This unit is ideal when a process has to be timed and controlled. Measures a tiny 52Wx49Hx18Dmm. See cat P266 for details. Cat. XC-0124

SAVE $10

WAS $19.95

July Only $9.95

N64 CONTROL PAD EXTENSION LEAD

Are you sick and tied of seeing your child's N64 sitting in the middle of the living room? If so, then you need one or two of these. See cat P150 for details. Cat. WV-7424

SAVE $10

WAS $16.75 July **$6.75**

PORTABLE SPORTS / PROCESS TIMER

Ideal for tradesman who charge for their time by the hour. See cat P266 for details.Cat. XC-0122

SAVE $12.50

WAS $24.95 **$12.45**

HALF PRICE

CABLE TIE PACKS

Made of black nylon and are resistant to UV. See cat P85 for details.

CRAZY PRICES!

150mm x 500Pcs Cat. HP-1212

WAS $25.75 July **$9.95**

SAVE $15.80

200mm x 500Pcs Cat. HP-1213

WAS $32.95 July **$12.95**

SAVE $20

TELEPHONE AND DUAL MAINS PROTECTOR

See catalogue page 122 for details. Cat. MS-4028

NEW **$29.95**

STICK ON MINI CLOCK/COUNTDOWN TIMER

This unit will count down from a maximum of 99 minutes and 59 seconds and will sound a beeper or flash an LED to indicate expiration of the set time. See cat. page 265 for details. Cat. XC-0222

SAVE $3.45

WAS $9.95 July **$6.50**

16 DRAWER PARTS CABINET

Prefect for separating resistors, capacitors, nuts, bolts, semis, etc or any little 'bits & pieces' that need storage. See catalogue page 290 for details. Cat. HB-6319

SAVE $3

WAS $9.95 July **$6.95**

Buy 10 for $60

AMAZING PRICE

Pkt 8 STEEL CORNERS - BLACK

This packet of 8 steel covers to protect the front corners of PA speaker, yet not require fastening to the front baffle. See catalogue page 221 for details. Cat. HM-3844

HALF PRICE

SAVE $7.75

WAS $15.25 July **$7.50**

PUSHBIKE COMPUTER

Track distance traveled, your average speed and peak speed, as well as the elapsed time. See catalogue page 262 for details. Cat. XC-4500

SAVE $10

WAS $29.95 July **$19.95**

NEW JAYCAR KITS

MULTIPURPOSE FAST BATTERY CHARGER

NEW

Refer Silicon Chip June 2001

This intelligent and versatile charger can charge a huge range of batteries voltages and types: 1.2V to 14.4V in 1.2V steps for Nickel Cadmium (NiCd), Nickel Metal Hydride (NiMh) and Lithium Ion (LiON) from 1.2Ah to 4Ah, as well as Sealed Lead Acid Gel Cell (SLA) and lead acid batteries at 6 or 12V @ 1.2Ah+. It has more intelligent features than what we can list here. Some features include discharger for NiCd & NiMh, Voltage limit charge for SLA & lead-acid, Voltage drop (dV/dt) & Temp rise (dT/dt) full charge detection for NiCd & NiMh, Under and over temp cutout, timeout & fuse protection and multi-LED charge indicators. See website for more details. This is the ultimate battery charger. Kit supplied with case, PCB & all electronics parts to build the complete unit. Cat. KC-5315

$229.95

FOUR CHANNEL CCTV SWITCHER

NEW

Refer Silicon Chip June 2001.

Display up to 4 CCTV cameras sequentially on your monitor. Variable scan rate and pause function. RCA sockets for video and audio signal. Kit supplied with punched and silk screened case, PCB & all electronics parts to build the unit. Requires 12VDC / 150mA. Cat. KC-5316

$89.95

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

COVERNIGHT DELIVERY

OVERNIGHT DELIVERY

RESPONSE

HI-Q 7 x 10" CAR SPEAKER

See catalogue page 235 for details.
Cat. CS-2291
WAS $115ea
SAVE $20
Now $95ea

USB LEAD MADNESS

We have made a scoop purchase of 2 metre A to B USB leads. Colour is black (white pictured). Hurry limited quantity.
Cat. WC-7543
SAVE $$$
1+ $5.95
4+ $5.45
9+ $4.95

PROGRAMMABLE DIGITAL THERMOSTAT 250VAC/5A

SAVE $18

Can control temperatures from 5°C to 35°C. Designed for use with oil, gas or electric heaters. See catalogue page 267 for details.
Cat. QT-7196
WAS $47.95
Now $29.95

TESTING LOUDSPEAKERS

BY JOSEPH D'APPOLITO
See catalogue page 299 for details.
Cat. BA-1420
WAS $79.95
SAVE $20
Now $59.95

ELECTROSTATIC DESIGN AND CONSTRUCTION

See catalogue page 299 for details.
Cat. BA-1406
WAS $49.50
SAVE $13
Now $36.60

NATIONAL SEMICONDUCTOR AUDIO/RADIO HANDBOOK

NEW

This book is a must for audio experimenters and technicians alike. See cat page 299 for details.
Cat. BA-5040
$39.95

INVERTER SELLOUT

See '99/00 Cat. for all 12VDC Input to 230VAC except*

Remote Control for MI-5045/55
Was $119 Save $30
Cat MI-5056
$89

24V 200 Watt
Cat. MI-5039
$109
Was $120
Save $11
LIMITED QTY

12V 920 Watt
Cat MI-5045
$499
Was $599
Save $100

SINEWAVE

12V 350 Watt Sinewave
Cat. MI-5060
$349
Was $429
Save $80

12V 750W Sinewave
Cat. MI-5055
$769
Was $969
Save $200

12V 500 Watt
Cat. MI-5052
$309
Was $329
Save $20
Limited Qty

CIRCUIT SOURCE BOOK 1

Now $15.95
SAVE $4
Cat. BB-7005
WAS $19.95

CIRCUIT SOURCE BOOK 2

Now $15.95
SAVE $4
Cat. BB-7006
WAS $19.95

See catalogue page 296 for details.

REMOTE KEYSWITCH PAD

Ideal for securing access to buildings, gates, etc. See catalogue page 175 for details.
Cat. LA-5354
WAS $39.95
SAVE $10
Now $29.95

JC50 10" 3 WAY SPEAKER KIT SPECIAL

See cat P213 for details

Quotes from Rob Evans of Electronics Australia magazine: "The JC-50's sound very good indeed. This is not a statement given lightly either." "The sound is consistent and balanced over a wide range of listening angles" "The treble range is very extended and detailed, while the low end delivers a nice degree of low end 'punch' without sounding lean or soggy" "This all adds up to a speaker system that's very enjoyable to listen to over it's full power range, with no sign of listening fatigue. You'd normally pay thousands of dollars for that privilege"
Cat. AA-0128
Cat Price $859
SAVE $200

FULL KIT WITH CABINETS ONLY $659

TOOLBOXES WITH DETACHABLE STORAGE LIDS

See catalogue page 289 for details.

12" MODEL
Cat. HB-6327
WAS $9.95
SAVE $2
$7.95

17" MODEL
Cat. HB-6326
WAS $15.95
SAVE $3
$12.95

6 Way Power Board

July $29.95

WITH MAINS FILTER AND TELEPHONE LINE PROTECTION
Ideal for phones, faxes, modems, computer systems etc etc.
Cat. MS-4035
WAS $43.95
SAVE $14

Small Zip Up Storage Case

HALF PRICE

Identical to our small zip up tool cases. These cases had a small print on the cover which has been removed with turps which left a small mark. For this reason you can pick one up this month for half price.
Cat. HB-6391
$4.95

PHOTO & CARD LAMINATOR

Accepts photos etc. up to 6" x 4" (100 x 150mm). Operates on 240 volts.
•Size: 205L x 84W x 96Hmm
See Cat. page 268 for details.
•Weight: 720g Cat. XL-2502
$59.95

SLEEVES TO SUIT:
95x57mm Cat. XL-2504 Pkt 100 $7.50

A4 LAMINATOR

•Size: 380(L) x 200(W) x 93(H)mm
•240VAC
•Weight: 4.04kg
•Preheat time: 8-14 minutes.
See Cat. page 268 for details. Cat. XL-2508
$179

SLEEVES TO SUIT:
156x112mm Cat XL-2505 Pkt 24 $7.95
A4 Size Cat XL-2512 Pkt 25 $13.95

RESPONSE

DOME TWEETER

SAVE $10

This 25mm dome tweeter has an impedance of 8ohms features a ferrofluid cooled voice coil. See catalogue page 203 for full spec.
Cat. CT-2010
WAS $26.95
Now $16.95

SAVE ON NI-MH RECHARGEABLE BATTERIES

LIMITED QUANTITIES AVAILABLE

DESCRIPTION	CAT #	Was	Now	Save	10+
AA 1400mAh NI-MH - TAGS	SB-2437	$4.55ea	$3.40ea	$1.15ea	$2.95ea
SUB C 2500mAh - TAGS	SB-2432	$8.95ea	$6.95ea	$2.00ea	$5.95ea
C SIZE 3300mAh	SB-2433	$11.45ea	$8.95ea	$2.50ea	$7.75ea
D SIZE 7400mAh	SB-2434	$24.90ea	$21.90ea	$3.00ea	$19.50ea

OVERNIGHT DELIVERY

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

6 WAY PCB MOUNT SCREW TERMINAL BARGAIN

NEW!

Grey colour, 5mm spacing.
Limited quantity available.
Cat. HM-3176

1+ $1.95ea
10+ $1.75ea
50+ $1.55ea
CRAZY PRICE

FUJITSU 240V 4PDT RELAY BARGAIN

NEW!

A high quality Japanese made relay at an unbeatable price. Brief Specs. •Coil: 240VAC •Contacts: 4PDT Silver Rated @ 3A •Rated Coil Current: (@200V) 6.6mA •Pick-up V: 80% of max rated coil voltage •Drop-out V: 30% of min rated voltage

•Service life: 5 x 10^7 ops min.
The relay has pcb mount terminals.
Manufacturers # FRL-264A240/04CS-01
Cat. SY-4012

1+ $14.95ea
10+ $13.35ea
25+ $11.70ea

FUJITSU 5VDC SPDT RELAY BARGAIN

NEW!

A high quality Japanese made relay at an unbeatable price. Brief Specs. •Coil: 5VDC •Contacts: SPDT Silver Cadmium Oxide Rated @ 15A •Coil Resistance: 40Ω +/-15% •Pick-up V: 75% max rated coil voltage •Drop-out V: 10% of min rated voltage

•Service life: 5x10^6 ops min.
The relay has PCB mount terminals.
Manufacturers # FRL-264 D006/01CK
Cat. SY-4014

1+ $9.95ea
10+ $8.75ea
25+ $7.75ea

BARGAIN PCB MOUNT TRANSFORMER

A quality little transformer rated at 7VA total 240V primary. 2 separate secondary windings. Winding A 11.0V @ 0.18A Approx.
Winding B 6.6V @ 0.70A Approx.
Size 41 x 33 x 35(H)mm.
Limited quantity. Be Quick. Cat. MF-1208

NEW!

1+ $4.95ea
10+ $4.45ea
25+ $3.90ea

E-CORE & BOBBIN SET BARGAIN

NEW!

This transformer core and former set is manufactured by Siemens Matsushita and used in a number of switch-mode power supply and flyback transformer designs. The bobbin has 8 solderable pins to allow for tapped primary & secondary windings and accepts the twin B66311 ferrite E-cores. Once wound, the transformer is capable supplying around 15 watts. This is a frequently used component and winding details are available from a number of internet sites. Core size 20.4(W) x 10.1(H) x 5.9(T)mm. Bobbin size approx. 20mm square x 15mm high. Cat. LF-1205

1+ $2.00ea
10+ $1.80ea
20+ $1.60ea

MINI LAB MAGNIFIER LAMP

This attractive little lamp incorporates a 90mm diameter lens with a 12-Watt circular globe. Magnification is 3 dioptres and the lens includes a hinged cover for protecting the lens. See catalogue page 261 for details.
Cat. QM-3520

$79.95

NEW!

LAB BENCH MAGNIFIER LAMP

SAVE

NEW!

This lamp features a 115mm, 3 dioptre magnifier lens surrounded by a 22-Watt circular globe in a quality ABS head, mounted on a quality steel cantilever arm. See catalogue 261 for details.
Cat. QM-3522

ONLY $149

PLAYMASTER III STEREO PRO SERIES AMPLIFIER KIT

Buy in July and receive a 20 metre roll of Heavy-Duty OFC Monitor cable (WB1736) FREE - **$89.95 value.** •185WRMS per channel @ 8 ohms. •355WRMS per channel @ 4 ohms.See cat P4 for full specifications. Cat. KA-1760

$599

HALOGEN CYCLE LAMP

Make sure that you can always see where you are going and are visible to other motorists whilst riding your bike on the road. See cat. page 259 for details
Cat. ST-3040

SAVE $10

WAS $29.95
July $19.95

THE CASINO 100Pc BIT DRIVER SET

NEW!

This set contains every bit you could possibly ever need. This is what you get - (All in tool steel):
1x Magnetic bit holder, 1 x Square to hex socket driver 50mm, 1 x Square to hex socket driver 25mm, 1x Square to hex bit adaptor, 9 x Phillips, 9 x Posidrive, 4 x Square drive, 9 x Slotted, 4 x Pin drive, 9 x Torx, 3x Torque Set, 7 x Tamper proof Torx (Metric), 9 x Hex (Allen) Metric, 4 x Tri-Wing, 3 x Clutch drive, 10 x Hex (Allen) Imperial, 3 x Spline drive, 6 x Tamper Proof Allen (Metric), 6 x Tamper Proof Allen (Imperial), 1x Wing Nut Driver Bit.
See Cat. page 45 for details. Cat. TD-2038

$29.95

VELLEMAN HANDHELD CRO

Cat. QC-1906

$279

CRAZY PRICE

BULK USERS

CONTACT OUR WHOLESALE DEPARTMENT FOR SPECIAL PRICING
(02) 9741 8552

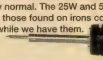
240V Soldering Iron Bargains

We've made a scoop purchase of some 240V mains soldering irons. They are priced way way below normal. The 25W and 50W have super high quality handles, similar to those found on irons costing well over double the price. Grab a couple while we have them.

25 WATT
Cat. TS-1410 $15

50 WATT
Cat. TS-1415 $20

80 WATT
Cat. TS-1420 $22.50



Limited quantities available

EMAIL ORDERS

mailorders@jaycar.com.au

Key Ring Laser Pointer

•3 x LR44 batteries (supplied). •Max output: < 1mW
Cat. ST-3102

$12.95

TEMPERATURE CONTROLLED SOLDERING STATION

$179

This 60 watt iron features a slimline, lightweight pencil with a super flexible silicon cord for easy use. See cat P40 for details.
Cat. TS-1380

DURATECH

Buy this month and receive FREE a hi-quality metal solder sucker Cat TH1862 valued at $15.75

AUDIO VALVES

12AX7WA/7025

NEW!

Russian made SOVTEK brand dual triode preamp valve used in countless musical instrument amplifiers and high-end hi-fi equipment. See cat P279 for details.
Cat. ZA-6000

$24.95

EL34FM/6CA7

NEW!

Russian made Electro-Harmonix brand power pentode manufactured to the original Mullard (UK) specifications. As used in many Marshall musical instrument amplifiers and ultralinear output stages of Hi-Fi amplifiers. See cat P279 for details.
Cat. ZA-6005

$39.95

6L6GC/5881WXT

NEW!

Russian made SOVTEK brand power pentode used mainly in musical instrument amplifying applications. This exact valve has been voted Best Buy by Vacuum Tube Valley (USA) issue 13. Recreates the tone of NOS Mullard (UK) 6L6GC's. See catalogue 279 for details.
Cat. ZA-6010

$39.95

SAVE ON DIGITAL INTERFACE CONVERTERS

Having trouble connecting your home audio system together? These products allow conversion from the toslink format to the Sony/Phillips Digital Interface and vice versa. See catalogue page 224 for details.

OPTICAL TOSLINK TO S/PDIF COAXIAL CONVERTER

SAVE $7

Cat. AA-1720
WAS $39.95
Now $32.95

S/PDIF COAXIAL TO OPTICAL TOSLINK CONVERTER

SAVE $7

Cat. AA-1722
WAS $39.95
Now $32.95

OVERNIGHT DELIVERY

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OVERNIGHT DELIVERY

MAILORDERS - FREECALL FOR PHONE ORDERS - 1800 022 888

AURA INTERACTOR

Some of the cartons are slightly scuffed, but the contents inside are perfect!

BACKPACK & CUSHION

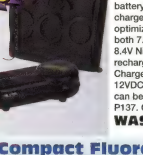
This is by far the best, and now most cost effective way of adding a new dimension to your home computer, video gaming console, or TV.

CRAZY PRICES

Backpack

Cat. XC-1000

$19.95



Cushion

Cat. XC-1005

$29.95

KITS INCLUDE:

Cable Set	
Cat XC-1001	$9.95
15W Amplifier	
Cat. XC-1006	$5.00
Shaker Actuator*	
Cat. XC-1008	$24.95
Power Supply	
Cat. MP-3055	$24.95
Total Value	$64.85

*Installed inside both the Backpack & Cushion

RC CAR BATTERY CHARGER 7.2, 8.4V

Remote control car battery charger optimized for both 7.2 and 8.4V Ni-Cad rechargeable batteries. Charger is powered from 12VDC so this portable charger can be used trackside. See cat. P137. Cat. MB-3515

SAVE $10

July **WAS $39.95 $29.95**

NETWORK CABLE TESTERS

This tester is suitable for TIA568A/568B, 10/100 Base-T (STP/UTP) as well as ethernet (Coax). The tester will automatically check cables for open circuit, short circuit and incorrect wiring. See catalogue page 154 for details.

Cat. XC-5080

July **WAS $89.95 $69.95**

SAVE $20

'DEBUG' FEATURE

Similar in function to XC-5080 but with the added convenience of a 'debug' feature which will identify on which pair the fault exists. See catalogue page 155 for details.

Cat. XC-5082

SAVE $20

July **WAS $209 $189**

10 Pkt 3.5" FLOPPY DISKS

Pre-formatted to suit IBM compatible machines. See catalogue page 157 for details.

Cat. XC-4739

July **WAS $6.20 $4.85**

SAVE $1.35

WE HAVE SLASHED THE PRICES ON MEMORY CARDS

Perfect for digital cameras PDA's, PC/'s, MP3 players-etc!

PRICES SLASHED

Smartmedia™ Memory Card NEW

Rewritable, non-volatile storage medium for high capacity portable devices such as Digital Cameras, PDAs, MP3 players etc. Fully compatible with SSFDC/MCIA release 2.1.

•45 x 37 x 0.76mm

	WAS	Now	SAVE
16mB XC-4775	$99.95	**$64.95**	$35
32mB XC-4776	$165	**$119.00**	$46
64mB XC-4777	$295	**$209.00**	$86

Compactflash™ Memory Card NEW

Rewritable, non-volatile storage medium. Fully compatible with PCMCIA & PC Card ATA standard. •36.4 x 42.8x3.3mm

SAVE $$$

	WAS	Now	SAVE
16mB XC4771	$99.95	**$79.95**	$20
32mB XC4772	$165	**$119.95**	$45
64mB XC4773	$295	**$195.95**	$99
128mB XC4774	$459	**$379.00**	$80

PRICES SLASHED AGAIN THIS MONTH!

12VDC Compact Fluoro Lights

Amazing Technology Breakthrough! These look like standard PL compact fluoro lights, but they are in fact 12VDC operated. They suit an E14 miniature edison screw base. Clever input circuitry means you dont have to worry about voltage polarity. •To mount, use our E14 base, Cat. PS-4072. 2 types available.

13 Watt 3D Tube

Equivalent to a 60W standard globe in light output. Size 140mm total length. Current draw 800mA.

Cat SL-2850 **$26.95**

20 Watt 3D Tube

Equivalent to a 100W standard globe in light output. Size 150mm total length. Current draw 900mA.

Cat SL-2852 **$32.95**

E14 Base (MES)

This base suits the 12VDC Compact Fluoro lights shown above. •White in colour. •Miniature Edison screw

Cat PS-4072 **$3.95**

CDR MADNESS

SAVE

	CAT	Buy 1	Buy 10
PHILIPS GOLD	XC-4711	$2.45ea	$21.50
AVALON CD-RW	XC-4720	$2.95ea	$26.00
B GRADE	XC-4729	$1.20ea	$10.50
PRINCO 80MIN	XC-4713	$1.95ea	$17.50
PYROB BLACK 80MIN	XC-4714	$2.25ea	$19.50
AVALON PLATINUM	XC-4715	$1.50ea	$13.50

	CAT	
10 Pkt JAYCAR PLATINUM IN SLEEVES	XC-4716	$9.95
10 Pkt PYROD SILVER IN SLEEVES	XC-4717	$9.95
25 Pkt PYROD SILVER ON CARROSEL	XC-4712	$23.95
50 Pkt PYROD SILVER ON CARROSEL	XC-4718	$39.95

EMAIL ORDERS: techstore@jaycar.com.au

WHOLESALE EMAIL: wholesale@jaycar.com.au

Jaycar ELECTRONICS

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03-01

MAILBAG

Nokia Datasuite less than magic

Your Mobile Magic article in the March 2001 issue was very interesting reading, if not a bit too kind to the likes of Nokia.

I purchased the Datasuite 2.0 a few years ago and found it to be OK but overpriced. When I upgraded my laptop computer and reinstated it, I found out that infrared communications did not work any more, for the reasons you point out in the article. Hoping for a quick fix from Nokia proved elusive and when Datasuite 3.0 came out, I thought I would upgrade and thereby solve my problems. Not so.

Not only was it impossible to get the upgrade from Nokia but they kept referring me to dealers who did not stock it. They all wanted to sell me the new version complete, not the upgrade. You would think a large company like Nokia would have a website where you can just download these things using your credit card.

I finally did find it on the web but not from Nokia or one of their dealers. It was a freebie and I did not have the slightest feeling of guilt downloading it, under the circumstances. Needless to say, it did not solve my problem and I am very happy that I did not pay for it.

The point I am trying to make is that a multi-billion dollar company cannot make a small piece of comms software work. How ridiculous. And they keep advertising the product as being infrared-capable. Sure, if you like to run 6-year old software on an ancient laptop, it works fine.

Horst Leykam,
via email.

Historical articles needed

Am I correct in writing that SILICON CHIP is now the only Australian magazine catering for the electronics enthusiast? If so, then congratulations! I am very pleased that I can still find a magazine that has interesting articles and projects to build. Keep them coming.

However I think there is something missing: historical articles describing electronics from the past; similar to the articles written by the late Neville Williams. There must be a lot more stories to be told and a lot of information to be collected before it is lost forever.

In the past I have enjoyed the historical articles in SILICON CHIP such as the series on "The Evolution of Electric Railways" and "The Story of Electrical Energy". Any historical article is wonderful reading. Is there any more of this sort of material coming? They would 'round' SILICON CHIP up quite nicely. What do others think?

Duncan Graham,
Hamilton, New Zealand.

Licence required for cable installers

I read with interest your comments on electrical wiring. You may also be interested to know that the ACA (Australian Communications Authority) now stipulates that installers of alarm or computer cable (where it is fixed) require a licence. The "reason" behind this brain-wave is that these devices can be connected to the telecommunication network and licensing installers will stop them from possibly causing damage to their phone network, even though modems and alarm panels have inbuilt isolation (and have done so for probably more than 10 years).

The upside to this is that there are now a number of training programs available in the cabling areas. The downside (apart from the revenue collecting side) is that if Joe Citizen decided to run his own home computer network (cable behind the plaster and putting sockets in the wall) between his office and bedroom, he would be breaking the law unless he has a licence (assuming one of his computers is connected to the phone system).

The ACA "Cabling Provide Rules" book states that "cabling without a current registration or a current licence is a criminal offence punishable on conviction by fine". You can apply for a transitional registration which enables you to achieve ACA's competency requirements by 2 October 2003.

So now you need a licence to run wires. Makes you wonder what you will need a licence for next!

Phillip Star,
via email.

More information can be found at: www.aca.gov.au/standards/cabling www.standards.com.au (look up CCM.PACKAGE. Communications Cabling Package cost $165.00).

Australian GPS software available

I really enjoyed your article on GPS for a PC in the April 2001 issue. I thought I would drop you a line on an Australian GPS software pack. It was written by Des Newman in Queensland with a trial package available at www.oziexplorer.com.au

This package allows the user to run moving maps scanned into a PC. Maps can be calibrated and used with almost all the features available on the most expensive GPS units.

Des provides a special price for Australian users who wish to upgrade to the registered program. This is by far the best program I have used for GPS and is always under review and upgrade.

Doug Braidwood,
via email.

Electrical engineers have little chance of a licence

In regard to Mr Hoolhorst's letter on pages 12 & 13 of the May 2001 issue, he is wrong in point 9 where he says that in Australia there is no way to avoid the 4-year apprenticeship. This is totally untrue. Even minimal research, like one or two phone calls, would have shown that there are many

ways to become a fully licensed electrician. I'm actually quite surprised that SILICON CHIP did not know this.

You can do a TAFE course "Electrical Wiring For Engineers", which allows you to sit an exam for an electrical contractors license. You are also eligible for this if you have done a TAFE associate Diploma or Diploma in Electrical Engineering.

After seeing the nightmare work of home handymen and wiring, I believe that unless you have a license, you should be heavily fined for even touching an electrical terminal. I've seen so-called handymen using speaker cable to run power, not using double-insulated cable, using unprotected cable outdoors, using the wrong coloured wires (I kid you not, Green/Yellow used as active), and making double-ended plug/plug extension leads.

The point is, this voltage is deadly. It only takes one idiot to wire something wrong in a house for it to kill people. You may think you know what you're doing but a little knowledge is dangerous.

Darryl Lewis,
Australian Broadcasting Corporation,
Enterprise Application Developer, Information Technology Services,
Ultimo, NSW.

Comment: firstly, NSW IS THE ONLY STATE that has a structured path for electrical engineers and associate engineers to become licensed electrical contractors.

Secondly, the Electrical Wiring course for engineers has been superseded by a new course, "Certificate III in Electrical Wiring". Why the new course? Many electrical engineers and associate engineers who properly completed the old course were then FIRMLY REFUSED LICENCES by the electrician dominated "assessment committee" and the resultant indignation forced the introduction of the new system where you have to be assessed and accepted as suitable BEFORE they allow you to do the course. MOST electrical engineers and associate engineers simply don't qualify!

An electrical engineer has to have had VERY CLOSE day to day involvement with the work of electrical installations of various types for AT LEAST TWO YEARS and MUST DEMONSTRATE A GENUINE NEED FOR A CONTRACTORS LICENCE before that engineer has any chance of making the grade with the electricians who make up the overwhelming majority of the members of the "assessment committee". A very important point here is that design experience is simply nowhere near enough, regardless of the type and period of that design experience!

For others with lower qualifications it is much worse. None of the various electronics qualifications, not even the Associate Diploma in Electronics Engineering, qualifies you to apply to do the "Certificate III in Electrical Wiring" and then gain a license. Only the Associate Diploma in Electrical Engineering is a suitable qualification enabling you to apply.

Secondly, an associate electrical engineer must have proof of not two (which is already too long) but AT LEAST FOUR YEARS of VERY CLOSE day to day involvement with the work of electrical installations of various types and again, MUST DEMONSTRATE A GENUINE NEED FOR A CONTRACTORS LICENCE before that associate engineer has any chance of gaining approval to do the "Certificate III in Electrical Wiring".

Help wanted on curve tracer

I bought an old Leader LTC-905 transistor/Fet curve tracer with probes and leads at the local markets for a few dollars and although it works fine, I don't know how to interpret the plots it makes on my scope when testing transistors. Perhaps someone out there either has a manual for it, or knows how to interpret the scope display.

john-richardson@bigpond.com

Transformer needed for Tektronix scope

I have a Tektronix 422/r422 with a defunct high voltage transformer (Pt No 120-0378-02). I am hoping there is someone out there who can tell me were I can get a replacement unit from. I would be very grateful and would pay all the required costs.

Mick Jezzard
(mjezzard@senet.com.au)
3 Comley St, Brighton, SA 5048.

Engineers and technicians are competent to do electrical work

I am commenting as an electrician about non-electrical personnel doing their own wiring. Firstly, I cannot understand why an electrical engineer is not permitted to do his own wiring, especially since he designs installations and therefore must know more than the average electrician. Silly rules like these must cause anger and frustration.

Electronics technicians also work on far more complicated circuitry than the average electrician. But I do believe the general philosophy and work practices are quite different for these two disciplines. A technician may find much of an electrician's wiring rough but providing the electrician runs cables beside beams, not over them, uses correct cable sizes and junction boxes and follows earthing requirements, the installation is safe.

I read the example where the electrician wired to the line side of a main switch; one can only call that electrician a goose. Some electricians also fail to check the condition of the MEN. I would have thought that to be his first priority as a bad or non-existent MEN is the most common cause of the fatalities we read about in the newspapers from time to time.

Tradesmen from all different trades know if a "trady" has done the work and so it is with an electrician. That is not to say I believe a technician cannot do a better job than me on an install. I also find it ridiculous that an electrician should electrically check a piece of equipment a technician manufactured. But I also believe an electrician has skills that a technician does not have, even though the circuitry is rudimentary.

I can understand the frustration of technicians; surely they should be allowed to cross-skill (it wasn't too long ago that an electrician could not cross-skill into refrigeration even though refrigeration involves lots of electrical work) but I do believe they need to be taught the philosophy of this trade.

But please keep wiring out of the hands of the general public. Let's not have such a closed shop but I believe some training is essential.

John,
via email.

The Simplest Digital Alarm Clock Ever

What has less than twenty components and can make sure you wake up in time for work, school, that early morning golf game . . . It's an alarm clock, of course. But it's not just any alarm clock . . . It's a PIC TOC!

Design by Michael Moore Words by Ross Tester

Now **before you say** *"Oh no, not another clock project..."* have a closer look at this one. It has just a handful of components yet offers features such as a melody alarm, high-brightness readout and a seconds display.

It's designed to operate from a plugpack supply but is just as happy running from a car or caravan battery (in fact, anything from about 9-17V DC).

So if you're travelling a lot and want a reliable alarm clock for the 'van or motorhome, this one is ideal. And you'll be able to knock it up in less than an hour.

Everything mounts on one small PC board and the "case", if you can call it that, is simply a cheap, tiny photo frame from your local bargain store (about two bucks' worth!).

And because it's based on a PIC micro, we've called it the PIC TOC. Oh, come on, it's not that bad! PIC TOC. TIC TOC. Geddit?

The circuit

As you might expect, to be as simple as what it is the clock uses just a single micro – in this case, the ubiquitous PIC16F84. All that is attached to the PIC is a 4MHz crystal-controlled oscillator (so it's nice and accurate), the push-button setting switches, a buzzer and four low current, high intensity 7-segment LED displays (via suitable resistors).

Apart from the power supply, that's all there is to the circuit.

The secret is, of course, in the software – in this case, the PIC is loaded with a program called alexcloc.hex. And just in case you're wondering, Alex is the little girl this clock was first built for. So now you know!

FEATURES:

- Cheap and easy to build!
- 4 very bright digits
- Push-button setting
- Melody alarm
- AM/PM indication

PortA 0-3 (RA0-RA3) of the PIC serves as the multiplexer, sourcing one of four seven-segment common anode LEDs in turn. These LEDs require just 3mA per segment and give a nice bright display straight from the PIC without the added complexity of driver or multiplexer circuitry.

3mA times 8 segments (don't forget the decimal points!) equals 24mA – just below the 30mA sourcing limit of a PIC16F84 I/O port.

The fifth PortA (RA4) is used to drive the audio output, which goes to a piezo buzzer. RA4 is an "open drain" output – that is, it will only go low, not high.

Because of this, some buzzers may require a resistor in parallel (say 1.1kΩ to keep it all nice and simple!) but in the case of the buzzer specified, no resistor is necessary. Provision is made for such a resistor on the PC board should it be needed.

PortB feeds the individual LED segments – when one of the PortB I/O pins (RB0-RB7) goes low, the segment turns on. Obviously, Port A controls on which digit the segment gets turned on.

PortA multiplexer outputs which are not having a turn as a source are kept in the high impedance input mode. This is more for experimental reasons than anything to do with the

The PICTOC is housed in one of the cheapest cases we've ever used: a $2.00 photoframe! But it sure looks the part . . .

design/software presented. By putting them into high impedance mode, it would be possible to add on additional common cathode 7-segment LEDs in parallel with the existing four common anode 7-segment LEDs, or add a set of switches. Port A can act as a Tristate 4-output pin multiplexer, giving each of 4 pins a turn at being a sink, a source, or off.

Incidentally, I had planned originally to add two extra 7-segment displays to the clock (ie, seconds) but decided not to do so because the extra LEDs would have reduced the brightness.

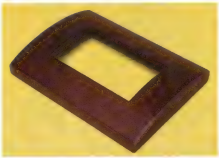
There is nothing to stop this circuit being adopted to become a frequency counter, tachometer or variable sweep generator with appropriate software – and in this case, brightness is probably less important.

Four switches are connected to the highest digit's PortA pin (RA0). Every hundred milliseconds or so, PortB (which normally drives the LED segments) is switched to input mode and RA0 goes low. If one of the switches is being pressed the relevant PortB input will be pulled low. The software detects which switch is being pressed.

Normally, these switches would short out the corresponding LED segment when pressed unless they were connected via a diode opposite in polarity to the LED segment. But in this case – a 12-hour clock – only three segments are used for the highest digit's display. So the four switches are connected to the unused segments, keeping the component count to a minimum.

The program

We are not going to attempt to print the program listing for alexcloc.hex – apart from taking a lot of pages, who in their right mind would type it out when you can download it, free of charge, from the SILICON CHIP website: www.siliconchip.com.au?



Here's another view of the photo-frame "case", this time sans bits. You cannot even see the glass – but it's there. We would have preferred a piece of red acrylic but didn't have any on hand. . .

This program can be loaded into your PIC using one of the PIC Programmers described earlier this year (January and March 2001 issues).

Alternately, it is expected that some kit suppliers will have available preprogrammed PICs.

There is only one hardware timer in the PIC16F84, and this is needed to keep a precise count for the clock. So it cannot be used to produce audio output – a software timer is used to regulate the audio tone instead.

All the main duties such as monitoring the hardware timer, keeping track of the time, multiplexing the digits and so on, are broken down into identical length subroutines. The main program counts these subroutines to time the period of the note that is being played and can therefore generate a note at the correct frequency.

The main program actually generates a tone continuously but the tone is inaudible unless a key is pressed or

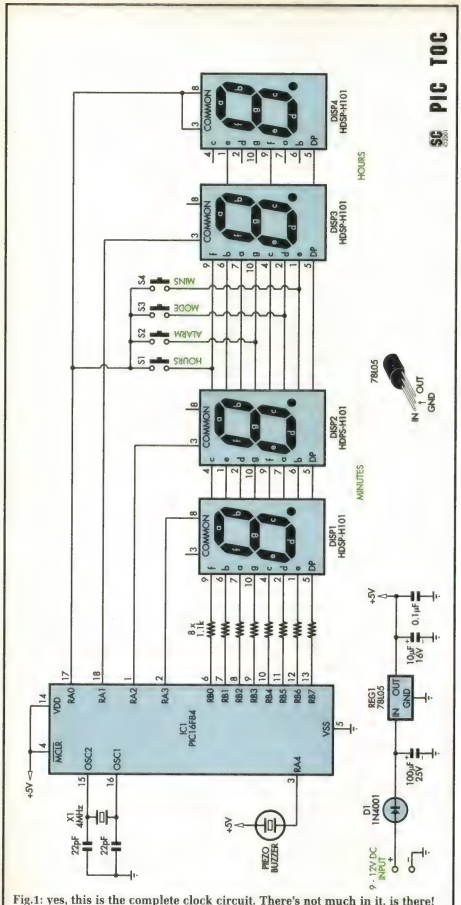


Fig.1: yes, this is the complete clock circuit. There's not much in it, is there! Just a PIC, oscillator, piezo buzzer and four setting switches plus power supply regulator make up the entire project.

the alarm goes off. The method is not exact but is exact enough – the ear cannot detect anything amiss!

Construction

The clock is housed in a tiny picture frame. OK, so it's not quite in – it's more ON the picture frame, surrounded by part of a plastic box. All components – switches included – mount on a small PC board, coded 04207011.

Most components mount in the normal way on the top of the board. The exceptions are the four time-setting switches, the main filter capacitor and the piezo buzzer, all of which solder to the back (copper side) of the board.

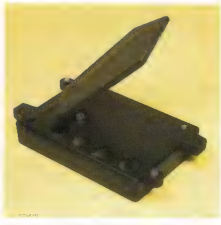
Start by cutting and soldering the various links on the PC board. Some of these are very close together and should therefore be insulated.

Also, room must be left for the 7-segment displays – some links are hard against the displays. One link, on the right side, actually goes around the end display so ensure enough length is left to achieve this.

Next, solder in the four LED displays. Note that two of these mount the opposite way to the other two (this gets the "colon" between the hours and minutes.

Note where the labels on the displays are and place them the same way as shown on the component overlay (Fig. 2).

Be careful soldering the pins – there isn't a great deal of room between them (the same comments apply to



Here's the DSE Utility Case after we "operated" on it to make it shorter than the maker intended! At 10mm high and with no "bottom", it's perfect for the switches to poke through as seen in a later photograph. The "stand" came from the original frame.

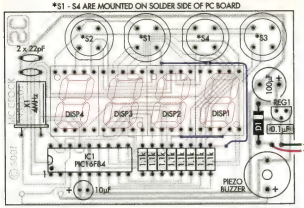
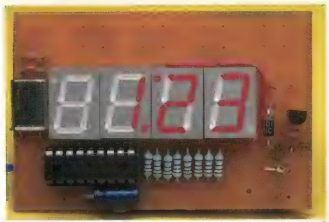


Fig.2: here's how the components go on the PC board. The four push buttons, 100µF electrolytic capacitor and piezo buzzer are mounted on the underside.



There are minor differences between this photo and the overlay at left (it's of an earlier prototype) but nevertheless will give you a good idea of where the bits go!

the PIC socket and the resistor array. Make sure the PIC socket goes in the right way around (cutout closest to the edge of the board).

If your eyes aren't as good as they once were (and perhaps even if they still are!) check for solder bridges with a powerful magnifying glass.

The PC board is designed for either an 8 x 1.1kΩ resistor array or eight individual 1.1kΩ resistors. We prefer the individual resistor approach because arrays are not only harder to find, they're more expensive.

Complete the top side construction by soldering in the polarity protection diode, regulator, crystal and various capacitors. Crystals and ceramic capacitors aren't polarized; electrolytic capacitors are. Note that the 10µF capacitor lays on its side.

Now turn the board over for soldering on the underside components.

Three of the switches – black, green and yellow – mount the same way with their flat side facing to the left when you look at the copper side of the board with the switches at the bottom. The fourth switch, the red one, mounts with its flat side facing upwards – see the component overlay again for a clearer picture.

You're going to need a very fine point on your soldering iron to solder the switch pins to the tracks underneath.

The 100µF electrolytic capacitor and piezo buzzer solder on the underside of the PC board. The capacitor (lying on its side) is easy because you have access to the legs. The buzzer is not so easy.

The way we did it was to apply solder to the copper pads, poke the piezo's leads through and then heat the leads from the top side. This melted the solder underneath and the joint was made. But it's not a method you'll find in the rules according to Hoyle (or whoever wrote the soldering rules!). Remember too that the piezo is polarised – it won't work the wrong way around.

Finally, solder in the wires to the DC supply socket. The socket should be connected with the positive to the center, which is the convention for plugpacks more often than not – until some idiot manufacturer decides his plugpacks are going to have negative to the middle!

There's not much room in the case to mount the DC socket – we managed to squeeze it in one side after making sure all the terminals were well covered with insulation to prvent shorting to the back of the PC board.

The protection diode will prevent any catastrophes if you do use a wrong-polarity plugpack – but of course, the clock won't work. You'll need to find a plugpack with the right polarity – anything capable of seven or more volts (up to about 17) and a couple of hundred milliamps will be fine.

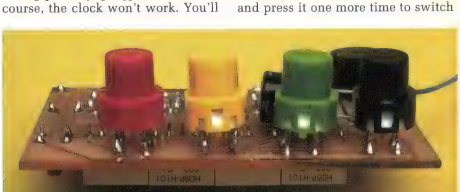
Carefully plug the pre-programmed PIC into its socket – the right way around and without bending any pins – and your clock is now electrically complete, ready for testing and then mounting in its case.

Testing

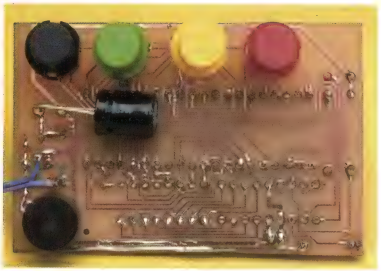
Apply power via the DC socket. The display should read 1:23, with a dot up in the left corner (indicating PM). And you should be greeted with a "ta-da" tone.

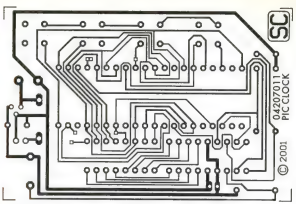
Press the black (mode) button – it cycles the display through its various modes.

Press once and the display changes from hours/minutes to seconds (preceded by a high-pitched tone), press it again it changes from seconds to alarm (preceded by a short melody) and press it one more time to switch



The purpose of this pic is two-fold: (a) to show the way we (carefully!!) soldered the four pushbutton switches to the back of the PC board (with the piezo buzzer and electrolytic capacitor somewhat hidden behind) and (b) to highlight the fact that two of the 7-segment displays are reversed with respect to their mates.





At left is the reverse (copper) side of the PC board (again, an earlier prototype than the final board whose same-size pattern is shown above). As you can see, this board also needed a bit of surgery due to over-etched tracks – something you need to check your board for.

back to clock mode again (preceded by a low-pitched tone).

If all this is OK, move on to checking the alarm function with the red button. Pressing this not only turns the alarm on (and of course off), it also lights the bottom right dot LED to show it is in alarm mode.

Finally, the green and yellow buttons are used to change the two left and two right digits respectively, incrementing the digits in both clock and alarm modes. In seconds mode the yellow button increments the minutes and the green button resets the seconds to zero.

If all this appears to be working as it should, you only have two more tests to make.

One is that the clock does actually work – set the time and ensure the digits change – and the other is that the alarm actually works – set the alarm time for, say, two minutes ahead and then wait that two minutes to ensure that Beethoven's Pastoral Symphony greets you!

Once you're happy it all checks out OK, it's time to place the clock in its unique case.

Parts List – PIC TOC

1 PC board, 50 x 75mm, coded 04207011
1 Plastic utility case, 57 x 82 x 33mm (DSE Cat H-2923)
1 Miniature wooden photo frame (with glass), 107 x 81 x 17mm with "photo" cutout 51 x 76 x 10mm (available from bargain stores)
1 2.5mm DC power socket
1 mini PC board mounting normally open single-pole pushbutton switch, red (Jaycar SP-0720 or similar)
1 mini PC board mounting normally open single-pole pushbutton switch, yellow (Jaycar SP-0722 or similar)
1 mini PC board mounting normally open single-pole pushbutton switch, green (Jaycar SP-0724 or similar)
1 mini PC board mounting normally open single-pole pushbutton switch, black (Jaycar SP-0721 or similar)
1 piezo transducer, PC board mounting (Jaycar AB-3459 or similar)
1 4MHz crystal
1 200mm length of insulated tinned copper wire (for links)
1 100mm length mini figure-8 (or two strands of rainbow cable)

Semiconductors

4 HDSPH101 high intensity, low current, 7-segment common anode LED displays (Farnell Electronics 324-723)
1 PIC16F84, pre-programmed with alexcloc.asm (downloadable from www.siliconchip.com.au)
1 78L05 low power 5V regulator (TO-92 package)
1 1N4004 silicon power diode

Capacitors

1 100µF 25VW PCB-mounting electrolytic
1 10µF 16VW PCB-mounting electrolytic
1 0.1µF ceramic or polyester (code 104 or 100n)
2 22pF ceramic (code 22 or 22p)

Resistors (0.25W, 1%)

8 1.1kΩ (brown brown red brown or brown brown black brown brown) *

* PC board will also accept an 8 x 1.1kΩ resistor array

The "case"

As we mentioned before, the clock mounts inside a cheap (two dollar) miniature photo-frame which we obtained from our local bargain store. The frame we used measures 107 x 81mm and is about 17mm deep but the more important dimension is the cut-out for the "picture".

In our frame it was 76 x 51mm – you'd almost think the PC board at 75 x 50mm was designed to fit, wouldn't you?

Our frame had a small piece of glass, against which you'd normally place the picture. Instead, we placed the PC board – the LEDs contacting the glass.

To be honest, we would have preferred a piece of 2mm-thick red acrylic in place of the glass – it would hide everything inside and accentuate the LEDs. But time beat us so we stuck with the glass.

Now, what holds the PC board in

place? You can't use the normal backing supplied but don't throw it out – we're going to use the support stand attached to it.

Instead, we used a Utility Box from Dick Smith Electronics. Actually, that's a lie: we used 1/3 of a Utility Box from Dick Smith Electronics. The box we used (H-2923) has cable entries and mounting points emerging from each end. We didn't need the cable entries but the mounting points we did!

The box is 57 wide, 82 deep and 33mm high. The width and depth are fine, the height is far too much.

So we removed the lid and carefully measured a line 12mm down from the case top, cut this with a hacksaw then smoothed it on a sheet of sandpaper (ie, rubbing it on the sandpaper, not the other way around). The photo shows you what we ended up with.

In the lid, we drilled 10mm holes for each of the four pushbutton switches and the DC socket (see photo above right).

And remember that support stand we mentioned a moment ago? This was also fastened to the lid to allow the clock to stand up vertically (again, refer to the photographs).

And it's finally assembled. We see a cut-down instrument case which holds the "works" onto the photo-frame. The four push- buttons set time and alarm. What you cannot see in this photo is the side-mounted socket for DC power input.

The PC board is not glued or screwed to the case – it doesn't need to be. Just pop the four push-buttons through their holes. (That's the reason the holes are slightly oversize – it allows for a little bit of error.) When finished, we simply placed the lid onto our piece of case and screwed the whole lot to the wooden frame using some 20mm self-tappers. (Drill a pilot hole in the frame first to avoid splitting).

If necessary, some foam rubber can be slipped in between the lid and the PC board to keep the LEDs hard against the glass in front.

And that's it. Plug in power, set the clock and settle back and enjoy!

Now, what can we do with 2/3 of a utility case without a lid? **SC**

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IT'S THE ONLY BATTERY CHARGER YOU WILL EVER NEED, EVER AGAIN!

FAST Universal Power Charger

Part 2
By JOHN CLARKE

For power tools, camcorders, R/C equipment and car batteries

Last month we introduced our new, improved Universal Fast Charger for a huge range of batteries. Here's the nitty gritty: how to build it!

It's **arguably the only** "high capacity" fast battery charger you'll ever need – ever again! It will easily handle all the batteries you have in your power tools – it will even charge your car or motor bike battery!

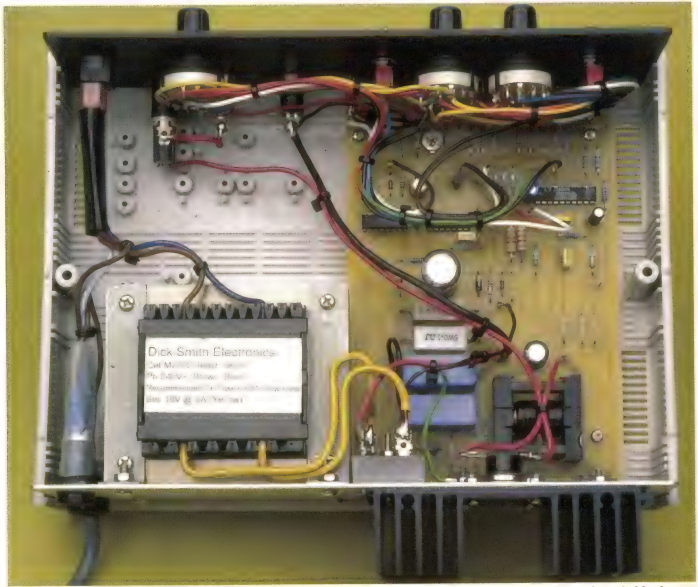
And while it won't handle low capacity "AA" cells it can charge their big brothers – 1200mAh and above – along with "C" and "D" types of 1200mAh or more. For a more detailed list, see the panel at right or refer to the full description of operation in last month's SILICON CHIP.

Main Features

- Fast charges Nicad, NiMH, LiION, SLA and Lead-Acid batteries
- Suitable for 1.2V, 2.4V, 3.6V, 4.8V, 6V, 7.2V, 8.4V, 9.6V, 12V & 14.4V batteries from 1.2Ah to 4.2Ah plus LiION 3.6V, 7.2V & 14.4V
- Charges either 6V or 12V SLA batteries from 1.2Ah to 4Ah
- Charges 6V or 12V Lead-Acid batteries of any capacity above 1.2Ah
- Includes a discharger for Nicad batteries
- Top-off charging at end of fast charge plus pulsed trickle charge for Nicad & NiMH
- Voltage limited charge for SLA & Lead-Acid batteries
- Voltage drop & temperature rise (dT/dt) full charge detection for Nicad & NiMH
- Under and over-temperature cutout for battery
- Over temperature cutout for charger
- Short circuit battery protection
- Time-out protection
- Fuse protection
- Multi-LED charge indicators

Construction

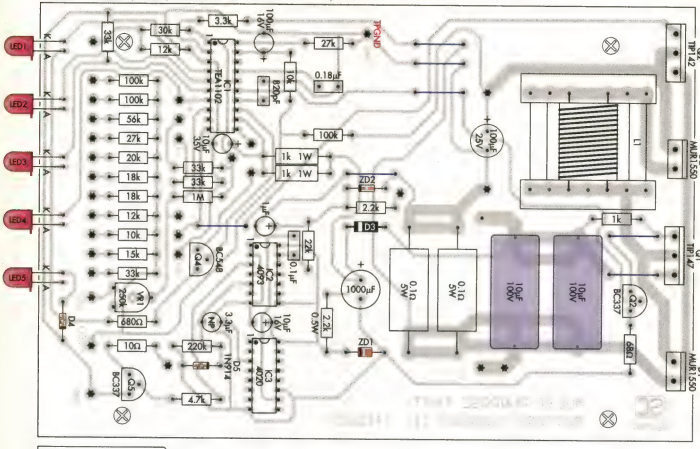
The SILICON CHIP Universal Fast Battery Charger is housed in a plastic instrument case measuring 257 x 190 x 85mm while the components are mounted on a PC board coded

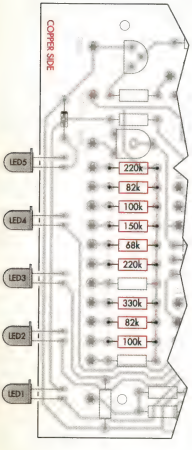


This photo shows the completed project, giving a good idea of where the various components are located. Probably the most difficult part is winding the inductor (bottom right) but even this is a snack!

LEGEND:
* = PC BOARD PIN
NP = NON-POLARISED (BIPOLAR) CAPACITOR

Figs 1&2 show both sides of the PC board, with the relevant section of the underside shown below.





14106011 and measuring 121 x 173mm.

If IC1 is the surface mount or " T" version, a small satellite PC board, coded 14302982 and measuring 29 x 16mm is also required .

Transformer T1 is mounted sideways onto the rear metal panel as shown in the photographs. Underneath its mounting position on the case are several integral ribs and bushes (mounting pillars). These must be removed to allow the transformer to sit flat.

The easiest way to remove the ribs is with a sharp chisel (careful!!) while the bushes are easily cut out with a large, sharp drill bit.

The main PC board fits over four integral bushes in the base of the case, secured with self-tapping screws. Other bushes (under the board) may get in the way of the PC board or components – again, these can be easily removed with a large drill.

Begin construction by checking the PC board against the published pattern. There should not be any shorts between, or breaks in, the tracks. If there are, repair these as necessary.

PC stakes are used wherever connections need to be made to the PC board. These are soldered in first, in the positions indicated. Doing these first also acts as a guide to the positions of the links and resistors, which can be soldered in next. Use the accompanying table as a guide to working out which resistor goes where – or measure them with a digital multimeter.

Note that some resistors are mounted as a parallel combination: one is inserted as normal from the component side of the PC board while the second (shown in red in Fig. 2 at right) is soldered between the pigtails of the first resistor on the underside of the PC board.

When inserting the smaller diodes and zeners, take care with their orientation and be sure to place each type in its correct place. Solder in the ICs and transistors, also taking care to orient them as shown.

As mentioned before, IC1 may be supplied as a surface-mount type. If so, it must first be soldered onto the small carrier PC board, which in turn is connected to the main PC board with wire links or pin headers.

Parts List – Universal Fast Battery Charger II

1 PC board coded 14106011, 121 x 173mm
1 PC board coded 14302982, 29 x 16mm (required for T version of IC1)
1 front panel label 244 x 75mm
1 plastic instrument case 250 x 190 x 80mm
1 aluminium rear panel to suit above case
1 heatsink 109 x 75 x 33mm (DSE H-3460 or equivalent)
1 18V 6A mains transformer (T1) (DSE M-2000 or equivalent)
1 ETD29/16/10 transformer assembly with 3C85 cores (L1) (Philips 2 x 4312 020 37502 cores, 1 x 4322 021 34381 bobbin, 2 x 4322 021 34371 clips)
1 NTC thermistor (DSE R-1797) (NTC1)
2 3AG panel-mount safety fuse holders (F1,F2)
1 630mA slow-blow 3AG fuse
1 7A fast-blow 3AG fuse
1 SPST Neon illuminated mains rocker switch (S1)
1 SPDT centre-off toggle switch (S2)
1 2-pole, 4-position rotary switch (S3)
1 4-pole, 3-position rotary switch (S4)
1 single pole, 10-position (1P10W) rotary switch (S5)
1 80°C thermal cutout (TH1)
1 momentary normally off push button switch (S6)
1 black 4mm heavy duty banana panel socket
1 red 4mm heavy duty banana panel socket
1 black 2mm micro banana panel socket
1 red 2mm micro banana panel socket
1 black 4mm heavy duty banana plug
1 red 4mm heavy duty banana plug
1 black 2mm micro banana plug
1 red 2mm micro banana plug
5 M4 screws x 10mm
6 M4 nuts and star washers
4 M3 screws x 10mm and nuts
1 M3 screw x 25mm and nut
4 self-tapping screws to mount PC board
4 insulating bushes for TO-220 and TO-218 packages
2 TO-218 insulating washers
2 TO-220 insulating washers
31 PC stakes
1 7.5A mains cord with plug
1 mains cord grip grommet
2 1mm spacers 10 x 5mm to gap L1
1 600mm length of red hookup wire
1 600mm length of green hookup wire
1 600mm length of blue hookup wire
1 600mm length of yellow hookup wire
1 600mm length of black hookup wire
1 300mm length of red heavy-duty hookup wire
1 300mm length of black heavy-duty hookup wire
1 150mm length of 0.8mm tinned copper wire
1 2m length of 1mm enamelled copper wire
1 55mm length of 15mm diameter heatshrink tubing
1 50mm length of 25mm diameter heatshrink tubing
10 small cable ties
2 solder lugs for earth terminals
2 10-way single in-line pin headers (if IC1 is surface mount "T" version)
5 5mm LED bezels

Semiconductors

1 TEA1102 or TEA1102T fast charge IC (IC1)
1 4093 quad Schmitt NAND gate (IC2)
1 4020 binary divider (IC3)
1 TIP147 PNP power Darlington transistor (Q1)
1 TIP142 NPN power Darlington transistor (Q2)
2 BC337 NPN transistors (Q3,Q5)
1 BC548 NPN transistor (Q4)
2 MUR1550, BYW81P/200 fast recovery diodes (D1, D2)
1 1N4004 1A diode (D3)
2 1N914, 1N4148 diodes (D4,D5)
1 35A 400V bridge rectifier (BR1)
1 12V 1W zener diode (ZD1)
1 11V 400mW zener diode (ZD2)
5 5mm red LEDs (LED1-LED5)

Capacitors

1 1000µF 63VW PC electrolytic
1 100µF 25VW PC electrolytic
1 100µF 16VW PC electrolytic
2 10µF 16VW PC electrolytic
2 10µF 100VW MKT polyester (Philips 373 series)
1 3.3µF bipolar electrolytic
1 1µF 16VW PC electrolytic
1 0.18µF MKT polyester
1 0.1µF MKT polyester
1 820pF MKT polyester or ceramic

Resistors (0.25W 1%)

1 1MΩ	1 330kΩ	3 220kΩ
1 150kΩ	5 100kΩ	2 82kΩ
1 68kΩ	4 33kΩ	1 30kΩ
2 27kΩ	1 22kΩ	1 20kΩ
2 18kΩ	1 15kΩ	2 12kΩ
1 10kΩ	1 4.7kΩ	1 3.3kΩ
1 2.2kΩ 0.5W	2 1kΩ 1W	1 1kΩ
1 680Ω	1 68Ω	1 10Ω
2 0.1Ω 5W		

Miscellaneous

Heatsink compound, solder, etc.

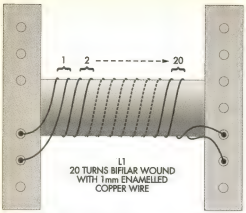


Fig.3: the detail of the inductor winding. It has two windings but both go on as one.

The power transistors and power diodes solder to the PC board but are also secured to the rear panel and heatsink. They are oriented with the metal flange towards the edge of the PC board and are positioned above the board with sufficient lead length to allow them to reach their mounting holes on the rear of the case.

Capacitors can be soldered in next. The accompanying capacitor table shows the various codes, one of which should be written on each component. The electrolytic capacitors must be oriented with the correct polarity (with the exception of the 3.3µF bipolar type which can be mounted either way). Now install the trimpot.

In similar fashion to the power transistors, the LEDs solder to the PC board and also emerge through the front panel. To allow this, the LEDs are inserted through the board with just enough length poking through to allow soldering. The LEDs are then bent over over so that they can protrude through the holes in the panel. We don't have to remind you to make sure they're the right way around, do we? No, we didn't think so. . .

The inductor (L1) is wound with two lengths of 1mm enamelled copper wire, wound in "bifilar" mode – the two lengths are wound as one with each turn of the winding actually being two turns side-by-side, one from each length of wire.

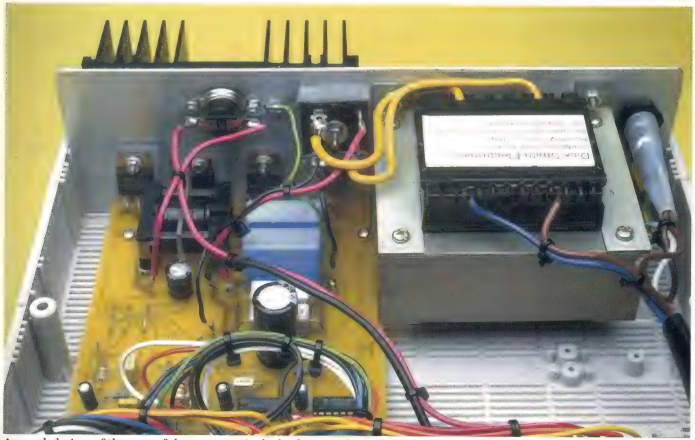
Fig.3 explains this method of winding. First, if the wire is supplied as a two-metre length (as specified in the parts list) cut it exactly in half. Now let's see . . . each length will be, uhh, um, too hard . . .

Next remove the insulation from one end of each of the two lengths of wire and terminate (solder) the two ends onto two pins on the underside of the transformer bobbin. The actual pins used doesn't matter since they are connected together on the PC board anyway.

Now wind on the two windings of 20 turns by holding both lengths of wire between your thumb and forefinger and winding them on as one (ie, side-by-side).

Once wound, cut the excess wires off, strip the insulation from their ends and terminate the wires onto the pins on the opposite side of the former. Again, the actual pins used are not important.

Insert one core in place and secure with a clip. Now place the 1mm spacers on the two faces of the inserted core and place the second core in position, securing it with the clips supplied. Insert this inductor assembly into the appropriate place on the PC board and solder in place.



An angled view of the rear of the case, particularly showing the method of mounting the power transistors and diode, the thermistor (with the red wires), bridge rectifier (block in the middle), transformer and mains wiring. Note that all mains wiring must be insulated with heatshrink tubing, as shown on the fuseholder at right of picture.

That pretty much completes the PC board assembly – all that's left now is to mount the board (and everything else) inside the case.

Assembly

Place the PC board into the case (on its four bushes) and mark out the positions for the power transistor and diode mounting holes on the metal rear panel (a fine-tipped felt pen is ideal).

Remove the rear panel from the case (it slides out) and drill out these holes plus two holes for the cord grip grommet and fuseholder in the position shown on the wiring diagram.

4mm holes are required for the transformer mounting and the earth termination plus the bridge rectifier mounting position above D1, along with the holes to mount the thermal switch TH1. All holes should be deburred with a larger drill, especially for the semiconductors to prevent punch-

Capacitor Codes

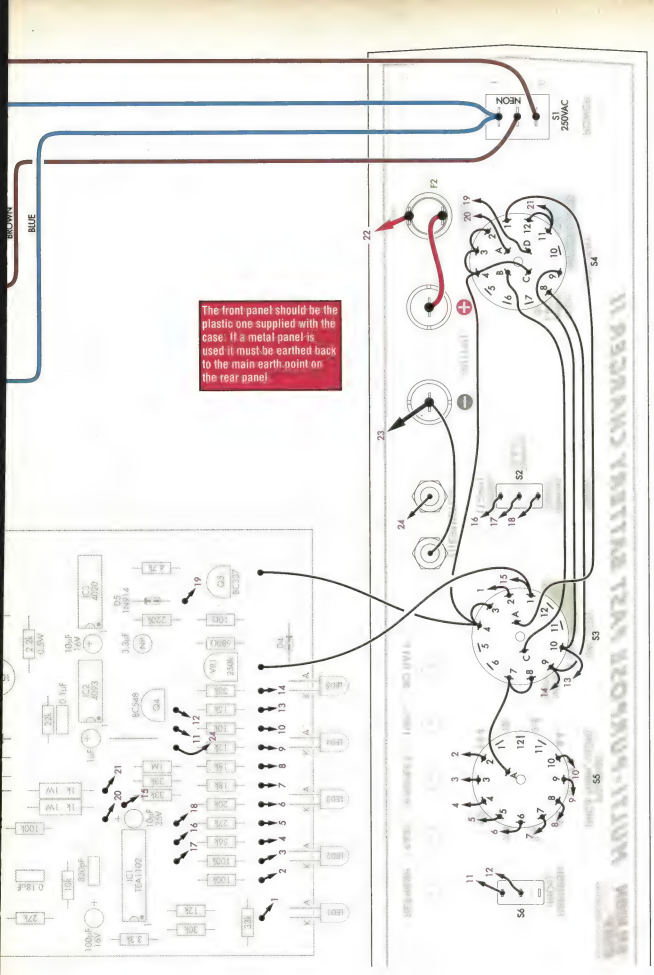
	Value	IEC	EIA
❑	0.18uF	180n	184
❑	0.1uF	100n	104
❑	820pF	820p	821

Resistor Colour Codes – Universal Fast Charger

	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❑	1	1MΩ	brown black green brown	brown black black yellow brown
❑	1	330kΩ	orange orange yellow brown	orange orange black orange brown
❑	3	220kΩ	red red yellow brown	red red black orange brown
❑	1	150kΩ	brown green yellow brown	brown green black orange brown
❑	5	100kΩ	brown black yellow brown	brown black black orange brown
❑	2	82kΩ	grey red orange brown	grey red black red brown
❑	1	68kΩ	blue grey orange brown	blue grey black red brown
❑	4	33kΩ	orange orange orange brown	orange orange black red brown
❑	1	30kΩ	orange black orange brown	orange black black red brown
❑	2	27kΩ	red violet orange brown	red violet black red brown
❑	1	22kΩ	red red orange brown	red red black red brown
❑	1	20kΩ	red black orange brown	red black black red brown
❑	2	18kΩ	brown grey orange brown	brown grey black red brown
❑	1	15kΩ	brown green orange brown	brown green black red brown
❑	2	12kΩ	brown red orange brown	brown red black red brown
❑	1	10kΩ	brown black orange brown	brown black black red brown
❑	1	4.7kΩ	yellow violet red brown	yellow violet black brown brown
❑	1	3.3kΩ	orange orange red brown	orange orange black brown brown
❑	1	2.2kΩ	red red red brown red	red black brown brown
❑	3	1kΩ	brown black red brown	brown black black brown brown
❑	1	680Ω	blue grey brown brown	blue grey black black brown
❑	1	68Ω	blue grey black brown	blue grey black gold brown
❑	1	10Ω	brown black black brown	brown black black gold brown

Here's a similar view to the facing page, this time looking from rear to front and showing the switch wiring. Follow the wiring diagram and photos and you should have no difficulties. Note that the front panel is plastic, providing insulation from the mains. If a metal panel is used, it must be securely earthed back to the main earth point on the rear panel.

Fig.4: the complete wiring diagram of the charger, shown with the two panels laid out and flat. The earth lug (top of drawing) should ideally be a crimped type, not a solder type.



The front panel should be the plastic one supplied with the case. If a metal panel is used it must be earthed back to the main earth point on the rear panel.

The thermistor mounted on its flying leads. Connection to the front panel is via miniature banana plugs.

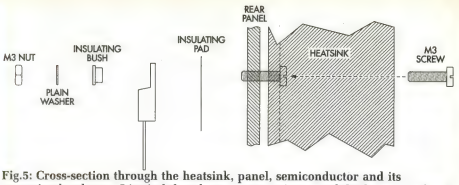


Fig.5: Cross-section through the heatsink, panel, semiconductor and its mounting hardware. It's vital that the power transistors and diode are insulated from the rear panel.

through of the insulating washers and to ensure a flat contact to the heatsink.

Place the heatsink against the rear panel and mark out the hole positions for drilling into the heatsink.

Note that you must line up the heatsink so that the screws for Q1, Q2 D1, D2, bridge rectifier and thermistor will pass through the heatsink between the heatsink fins. Drill out and deburr these holes.

Attach the PC board to the case with self-tapping screws.

Apply a smear of heatsink compound to the flat face of the heatsink and secure the transistors and diodes to the rear panel and heatsink with a screw, nut, insulating washer and insulating bush.

If you use a mica washer apply a smear of heatsink compound to the mating surfaces before assembly. (Silicone-impregnated glass fibre washers, much more common these days, do not require heatsink compound.)

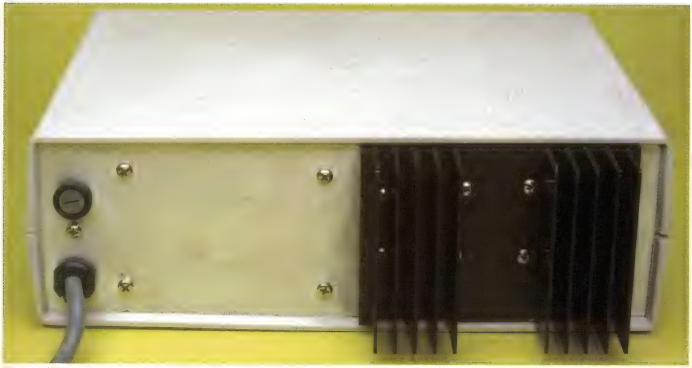
Check that the metal tabs of the devices are indeed isolated from the case by measuring the resistance to the case with a multimeter – it should show open circuit.

Apply a smear of heatsink compound on the face of the rectifier (BR1) before securing it to the rear panel. It is not necessary to insulate the rectifier case from the rear panel.

Pass the mains cord through its cord-grip grommet and secure the grommet into its rear panel hole. Also attach the fuseholder and secure the transformer with 4mm screws, star washers and nuts. Attach the earth wire (green/yellow stripe) to the solder lug (or preferably a crimp lug) and secure to the rear panel with a screw, star washer and nut.

The front panel can now be drilled out to accept the switches, terminals and fuseholder. We used bezels to mount the LEDs – they hide a multitude of sins, especially holes that don't quite line up! A photocopy of the front panel artwork (Fig. 6) can be used as a template for drilling. Attach the rear label in place after drilling and cut out the holes with a sharp hobby knife.

The shafts of the rotary switches need to be cut down with a hacksaw. Many rotary switches supplied these days are universal – the number of positions required need to be set. If this is the case, you will need to set S5 as a 10-position, S3 as a 4-position, and S4 as 3-position type.



Repeated from last month, this photo shows the mounting of the heatsink, transformer, mains lead and fuseholder. The screws in the heatsink go right through the panel to hold the power transistors and diode in place.

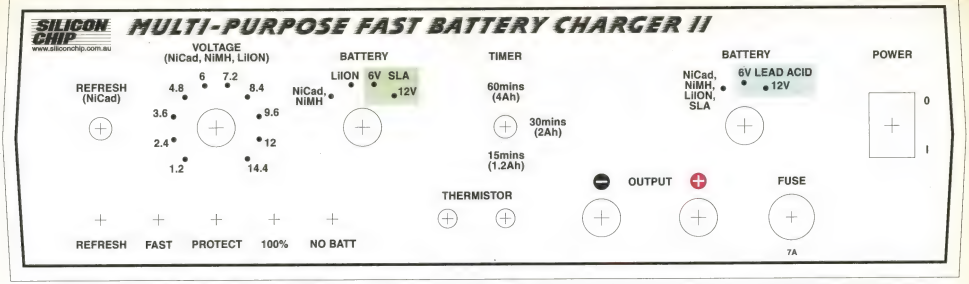


Fig 6: same-size artwork for the front panel. Use a photocopy as a drilling template. This label must be paper or plastic, notmetal, to ensure insulation integrity is maintained between the wiring and the user. If a metal panel is substituted for the plastic panel ensure it is properly earthed

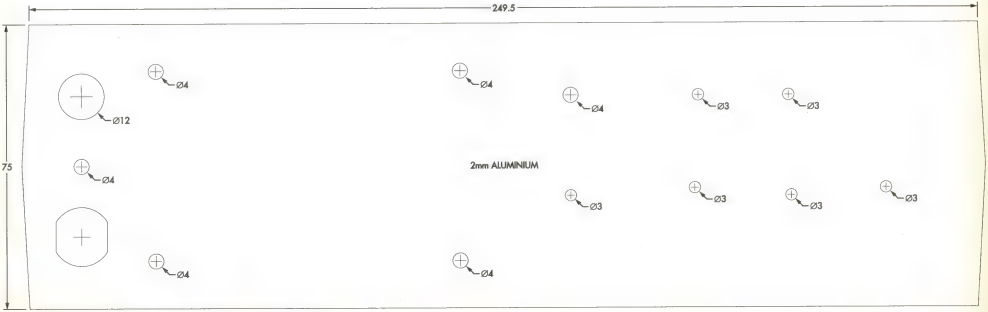


Fig.7: same-size drilling template for the rear panel.

This is done by removing the locking collar from beneath the star washer and nut and rotating the switch fully anticlockwise. Then reinsert the locking washer into position 10 for S5, position 3 for S4 and position 4 for S3.

Now assemble all the front panel components. Follow the wiring diagram, using coloured hookup wire.

The mains wiring must be done using mains-rated wire, with the terminals for the fuse and power switch sheathed (insulated) with heatshrink tubing.

Use heavy duty wiring for the connections between the rectifier and PC board, the thermal switch and to the output terminals and fuse F2.

Tidy up the wiring with cable ties and insert the front panel into it slots in the case with the LEDs protruding through their bezels.

You will need to make up some heavy-duty leads to connect from the output terminals to a battery, using heavy-duty banana plugs and large alligator clips.

The thermistor, too, requires a connecting lead. This can be light-duty figure-8 or twisted hookup wire, terminated in miniature banana plugs. The thermistor leads themselves should be sheathed in heatshrink tubing where they solder to the connection lead.

Testing

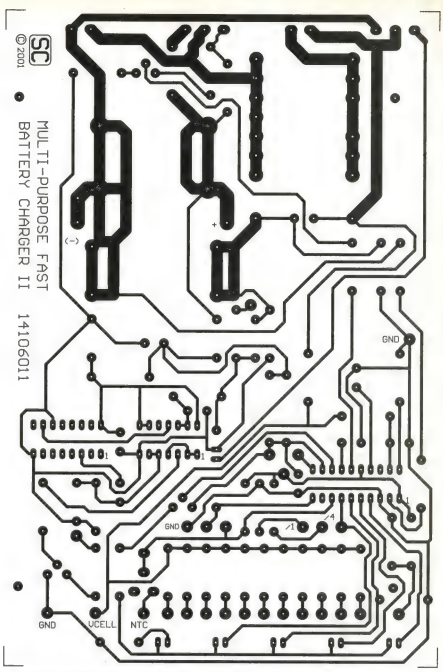
Check your work carefully to ensure correctly placed components, orientation of the polarised parts and wiring.

Test that the earth termination connects to the rear panel case by measuring the resistance between the earth pin on the mains plug and the case. It should be zero ohms (or very close).

Now apply power and measure the voltage between the TP GND PC stake and pin 12 on IC1. You should measure about 12VDC. Check that pin 14 and pin 16 of IC2 and IC3 are at 12V. Switch S3 to the NiCd & NiMH position and check that the "no battery" LED lights.

Connect the NTC thermistor and check that the voltage at pin 8 of IC1 is at about 2V when the temperature is around 25°C. Adjust VR1 for this voltage.

If you heat up the thermistor slightly by gripping tightly between your finger and thumb the voltage should drop. If the temperature rises then it is either a very hot day and your body temperature is lower than that of the air (unlikely during winter!) or you have the wrong type of thermistor (eg, a PTC instead of NTC).



Figs.8 & 9: full-size artwork for the main PC board and the optional daughter board, required only for a surface-mount IC1.

When charging a battery make sure you select the correct battery type and voltage on the front panel switches. Also set the timer for the closest timeout period for the particular battery capacity. If you are charging a lead-acid battery then the timeout setting does not matter.

You may wish to check the charge current using an RMS meter or a digital oscilloscope which reads RMS. If a standard multimeter (ie, not a true RMS type) is used, you can expect the reading across the two 0.1Ω resistors in parallel to be about 200mV. An RMS reading should show about 300mV which is equivalent to 6A.

Note that the heatsink and Q1 will run hot on fast charge and so the charger should be provided with sufficient ventilation to prevent the thermal cutout operating. SC

Backing Up Your Email

If you rely on your email system, you'll probably have a sizeable address book that you use regularly. Losing your address book, not to mention all those messages, could be a real pain, right? But how do you back them up?

by PETER SMITH

Microsoft's Outlook Express stores all address book data in .WAB (Windows Address Book) files. Each person that logs into a particular computer has his or her own address book. For example, if you log in as "George", your address book would be named **George.WAB**.

You could just copy all .WAB files to back up all address books but there is a snag. With version 5.x of Outlook Express, Microsoft introduced a new feature call "Identities", which enables multiple accounts to co-exist on the same PC using a single .WAB file.

To successfully back up a specific "identities" address book, you need to log in as that identity and perform an address book export. You can then back up the exported file for safekeeping. All message folders and associated files can be backed up directly – but how do you find out where they're stored?

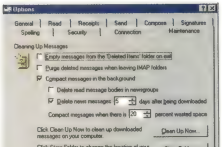


Fig.1: the Options dialog box for Outlook Express.

Fig.2: the Store Location dialog box.

Open Outlook Express and on the **Tools** menu, click **Options**. Click the **Maintenance** tab and then click on the **Store Folder** button. The **Store Location** dialog box displays the directory in question (Fig.2).

For step-by-step backup instructions, check out the following web pages:

http://support.microsoft.com/support/kb/articles/q188/8/54.asp (Outlook Express 4)

http://support.microsoft.com/support/kb/articles/q270/6/70.asp (Outlook Express 5)

Windows ME and DOS

Remember MS-DOS? If you've upgraded to Windows ME, you'll notice that Microsoft have given it the old heave-ho. In other words, you can't boot to a DOS prompt or run those real-mode games or utilities that you used to be able to with earlier versions of Windows. You can't even create a DOS startup disk!

Despair not. If you really can't do without the ">" prompt, then check out the following web sites that offer free patches and utilities to correct this obvious oversight by Microsoft!

www.overclockers.com.au/techstuff/a_dos_me/
www.geocities.com/mfd4life_2000/
members.tripod.co.uk/bootdiskmaker/boot3.htm

HyperTerminal Update

Do you use HyperTerminal? If so, you may have noticed that it has a number of annoying bugs. HyperTerminal is supplied free with Windows 95/98, Me and NT, and is part of the standard Windows installation.

Consider upgrading to version 6.1, available free to download from the Hilgraeve web site located at **www.hilgraeve.com**

As well as bug fixes, this latest version includes a couple of extra features as well. For Windows 2000 users, the HyperTerminal update is included in the recently released Service Pack 2.

Making A Quick Exit From Windows 98 – Just Click Once

Here's an addition to your Windows 95/98 desktop that you will use every day. It allows you to exit Windows at warp speed, using just one mouse click instead of the usual three!

Right-click on any blank space on the desktop. Choose **New -> Shortcut** and enter the following in the **Command line** box exactly as it appears below:

C:\WINDOWS\RUNDLL32.EXE C:\WINDOWS\SYSTEM\USER.EXE,ExitWindows

Note that there is no space after the comma and case must be as shown. Click the **Next** button and you will be prompted to select a name for the shortcut. Enter whatever you like, then click **Finish**. Make sure all applications are closed before double-clicking on your new shortcut!

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Jack O'Donnell, Managing Director

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Intelligent Programmable Remote Control

SAVE OVER 20%

Very simple to program and operate. Replaces up to ten remote controls plus adds up to 10 one-touch macro functions for armchair comfort.

Features: • Auto power save • Useable with all modern AV equipment (e.g. DVD) • Slide cover for sensitive buttons • Light sensitive Backlit display • Smart and easy to programme. • Programmable LCD display titles

A 1000 $99

Don't open the door to just anyone!

View who is at the door before you open it to strangers.

Features:
- Simple to install
- Includes CCD camera with IR illumination
- Camera activates as soon as the doorbell is pushed.
- Two way communication is possible through the telephone hand set and microphone.
- Camera and monitor can be up to 100m apart (15m lead supplied)
- Tamper switch on the camera unit is compatible with most security systems
- Monitor may operate an electric door strike (S 5385) so you can "buzz" your visitors in
- Includes 18V DC Plugpack.

S 9400 $349

Open your gate remotely

S 5385 $38

Install this door strike as a gate lock or in your front door and be able to "Buzz" in your visitors. Suitable for use with security doors, building entrances or exits or external gates.

Digital Thermometer / Hygrometer

NEW

Instantly gauge the humidity & temperature of a room with digital precision!
Ideal for wine cellars , computer rooms, fish tanks & home brew kits.
- Jumbo LCD display
- Dual display of internal / external temperatures
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- User temperature alarm settings
- Back lit
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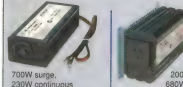
- Digital clock

A 6156 $40

Mains Power Anywhere! Anytime!

Portable mains power. Ideal for camping, or 4 wheel drive, enthusiasts. This range of inverters will power laptops, portable TVs, printers, incandescent lights & other similar small appliances.

Features: • Compact • Lightweight • Standard GPO type mains plug • Reverse polarity protection • Output overload protection • Over temperature protection • Soft start • Low battery voltage shutdown • Output short circuit protection



700W surge , 230W continuous power, 24V DC input

M 6113 $149

2000W surge , 680W continuous power, 12V DC input

M 6132 $329

Active Noise Reduction Aviation Headset

ANR (Active Noise Reduction) circuitry cancels unwanted external noise, reducing discomfort & distraction in noisy places. The C 9069 attenuates ambient noise by around 18dB.

Not just for pilots! Ideal for amateur racing pit crews, gold prospectors, heavy & farm machinery operators or anywhere there is extraneous noise.

Features: • Extra thick ventilated headpad • Corrosion proof steel frame • Soft gel filled polyurethane ear pads • Earphones wired in parallel for safety and reliability • Compatible with 150-1000 ohm systems • Adjustable volume control • Universal boom microphone, can be placed on left or right • High performance noise cancellation • Electret microphone

C 9068 $495

Bonus C 9075A Carry case. Keeps your headset in peak condition. Valued at $24.75 included at no extra charge

Black & White Monitor

This 10" monitor can accept up to 4 A/V inputs and will automatically switch between them.

S 9094 $295

Features : • May be configured to automatically switch between four A/V inputs • Manual override capability for monitoring a single input continuously.
• Variable switching interval • Video and audio outputs are provided for a recording VCR. • DC output for powering CCD cameras with internal voltage regulation.

Mini Mechanical Buzzer

S 6102 $20

Save over 40% on these super loud PCB mount mini buzzers.

Black & White Dome Camera

with IR illumination

The infra red LEDs will illuminate up to ~ 5m ahead of the camera. This makes it ideal for discrete surveillance in poorly lit areas

Features:
- Size 117 x 70mm
- 380 lines resolution
- Requires 14VDC power
- IR illumination to ~ 5m

S 9112 RRP $89 or 2 for $158

M 9449 500mA plugpack to suit $31.85

Black & White Quad Video Processor

Perfect for home or shop as a webcam by email!

Enables you to take 4 CCD camera inputs and display all of them on a split screen format. The unit can also flick between the 4 inputs sequentially at full screen. Monitor all corners of your premises at once!

S 9300 $359

Features: • Accepts up to 4 CCD camera inputs • Operates as a standard switcher • 75Ω BNC Video outs for both display and recording • Built-in real time clock "time stamps" the footage • Requires 18V DC 500mA plugpack. (Part No. M 9357)

Aussie Made Amp!

This month save over 20% on this Aussie made PA amp

Suitable for amateur theatres, schools or sporting clubs this 30W public address amp boasts features that would only be found on PA amps costing twice the price

Features: • Low noise and distortion levels • Push to talk (PTT) muting on microphone 1 • 3 balanced microphone inputs • Optional vox muting board available (A 1996) • 3 stereo auxiliary inputs • Bass and treble tone controls • Tape output • Output terminals for 100V line and 4 - 16Ω loads • 240V AC operation • Inbuilt short circuit protection • In-built thermal shutdown protection• 2 year warranty • Australian designed and assembled

A 2001 $209

Digital AM/FM Tuner

This stylish AM/FM tuner incorporates automatic and manual tuning to set the desired station. The design uses Phase Locked Loop circuitry to ensure the frequency does not drift once tuned

A 2700 $199

Features: • AM / FM PLL Synthesised Tuner • Inbuilt Digital Clock • 24 Preset Memories 16FM, 8AM • Battery backup for preset memory • Automatic / Manual Tuning • FM Stereo or Mono • Automatic Scan Search Mode • LC Digital Display • 240V Operation

Network cable tester

This unit will not only check all 8 conductors, but it will also check shielding integrity where shielded cable has been used. PLUS it can also check Coax wiring with the included BNC to RJ45 adaptor!

Features: • Auto / Manual mode • LED indicators for all connections including Ground• Will test 10Base-T, 10Base-2 ,RJ45, 258A, T1A 568A/568B and Token Ring • BNC to RJ45 Adaptor included • Includes Soft carry case

Extra giveaway ! Free this month with the D 3010 100 (that's right 100) P 1418 RJ45 Crimp plugs valued at $85.00

D 3010 $149

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1-800 999 007 Perth (08) 9328 1599

12 months minimum warranty

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Uninterruptible Power Supply (UPS)

12 Month Warranty!

Professional uninterruptible power supplies will guard your computer from damage caused by power failure. Supplied complete with monitoring software and cables to ensure your computer is carefully shutdown without data loss. 300VA will suit an average Pentium PC.

D 0850 $149

Please Note: These units were used at the Sydney Olympics although you can hardly tell!

PIR Mini Alarm / Door Minder

This simple wireless operation of this handy little gadget makes it ideal for a travellers alarm, or shop door minder.

Features: • 10 Metre detection range • Simple and easy to install • Self-contained unit • Swivel mount bracket • Battery or Plugpack operated • Door Chime or Alarm modes • Remote doorbell contacts • Doorbell only operation when in Off mode

S 5320 $29

Digital Sweep & Function Generator

This sweep/function generator has variable sweep rate and width, and functions as a standard waveform generator with sinusoidal, triangle and square wave outputs, all with variable DC offset and symmetry. Output frequency is adjustable via a front panel dial over seven ranges.

Q 1560 $599 Save $100

Features: • Tilt bail arm handle for bench standing angle adjustment • High brightness seven segment LED displays • BNC input/output connectors • Gate indication LED • Push button range and waveform switching • 2 MHz frequency counter

The quintessential guide to the ultimate design tool!

This book covers insider tips and hints from the creator of MultiSIM™, full demos of drag and drop circuit design letting you take a project from idea to finished project in minutes. It also features a CD rom Demo of EWB, MultiSIM™ and Ultiboard software including the circuits presented in this book.

B 2440 $79.95

NEW

The Ultimate Television Guide

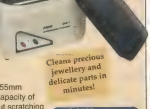
A comprehensive guide to Television stations and frequencies in rural australia. Covers all states and territories. Perfect for people on holiday or for people who are always on the move.

B 2195 $20

*Sorry not available from dealers

Ultrasonic Cleaner

Rejuvenate your jewellery or clean your pen nibs, fuel injectors, glasses, watches PCB's, computer connectors, switches or relays.



Cleans precious jewellery and delicate parts in minutes!

Features: • 170x 90 x 55mm stainless steel tank • Capacity of 600mls • Cleans without scratching delicate jewellery or glass • Uses water & household detergent

A 0102 $199

Eliminate your battery's memory

Keep your rechargeable batteries in peak condition

Memory effect can cause a rechargeable battery to lose storage capacity, reducing the number of hours use you get from your batteries.This smart charger automatically discharges your batteries then charges them up to full capacity. Cycling the batteries in this way prevents "memory" effect common in NiCads & increases battery life.

A 0288 $29

Features:

• Simple and easy to use • Charges up to 4 batteries at a time • Charge and Discharge LED Indicators • Includes automatic discharge then recharge function • 240V Operation • Suitable for AAA, AA, C, D, 9V batteries

8 in 1 Remote Control

This pre-programmed remote control is extremely easy to use. It can replace up to 8 controls and can operate the following items - TV, VCR, VCD, DVD, LD,CD, Tape, Amplifiers, Cable Set Top Boxes & some air conditioners. Compatible with over 400 brands!

A 1007 $24.95 NEW

SCHAFFNER TRAN. PCB Mount Toroidals

Save over 50% on these encapsulated PCB mount toroidals 2 x 120V to 2 x 15V

M 4515 $20

Look Mum, No hands!

This telephone headset allows you the freedom of hands free communication, which is ideal if you spend your life on the phone

Features: • Hands free operation, • Can be either desk mounted or worn on your belt • volume control • Dual tone ringer • Last number redial • Mute button • Removable belt clip. Ideal for home or office. (Not suitable for commander or similar systems)

P 7015 $55

Ratchet Screwdriver set

A reversible ratchet driver is an ideal tool to remove those stubborn screws without stripping them or for those tight spaces where there is little or no leverage

This set contains a reversible ratchet driver handle and a set of double ended driver bits including 4 flat blade, 4 philips, 4 pozidrive, 4 hex and 4 TORX heads. The ratchet direction is selected by a handle switch. The set comes in a sturdy storage case.

T 2190 $20

Breathe Easy

This negative ion generator removes dust & pollutants from the surrounding atmosphere. This allevates allergy sufferers to breathe easier!

Powered from a 12V source through your car cigarette lighter.

A 6125 $10

Pro Soldering Station

FREE!

Features: • Precise temperature control • LED Temperature Setting Display • Superior ceramic heating element • Zero-volt switching • Light weight ergonomic mini handle • Cleaning sponge tray incorporated in base • Temperature range 200 - 500°C • Temperature setting lock facility • Iron stand can be mounted either side • 4mm earthing point for anti-static strap

T 2438 $250

"We have been using the T 2438 for 10 hours per day for the last 12 months. Our technicians are impressed with the quick heat up time, accuracy of the temperature display and ease of use."
Richard Cope, Pentacom QLD

FREE*

*Purchase the T 2438 Professional Soldering Station above, *mention this ad* and we will throw in this T 2580 70W Go-Anywhere Gas Iron, T 2438 solder roll holder AND a roll of solder (T 1110) valued at over $59 absolutely ***FREE!***

Breadboards @ 30% off

P 1612 $26.95

An essential tool for engineers, designers, hobbyists. These breadboards allow quick changes to circuits. Both are mounted on an aluminium base with rubber feet and include binding post terminals for power supply connections.The P 1012 accepts up to 16 x 16 pin DIL ICs (1680 holes) and the larger P 1015 accepts up to 24 x 16 pin DIL ICs (2420 holes)

P 1016 $40

Test Equipment Clearance!

30 Range Digital Multimeter

- Temperature -50°C to 1100°C
- Data Hold
- Auto Power Off
- AC Volts < 200mV - 750V
- DC Volts < 200mV - 1000V
- Resistance < 200Ω - 20MΩ
- Continuity Buzzer
- AC/DC Current < 200µA - 10A
- Diode Check
- Includes high quality test leads & shock-proof rubber holster!

That's less than 1/2 price!

Q 1160 $54

*Sorry not available from dealers till this price

32 Range DMM with Frequency Meter

SUPER LARGE 3 INCH DISPLAY!

All the usual functions of a multimeter plus a frequency meter this unit is ideal for technicians or trades person's tool kit

Features: • Transistor tester • Capacitance up to 20µF • Resistance up to 200MΩ • Continuity/diode test • Temperature measurement • A massive 20A DC current range • Frequency counter up to 20kHz. • Includes thermocouple temp probe,rubber holster with bench stand and UL approved test leads

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Hobbyist Essentials!

This 24 piece combination tool kit contains all of the essential tools to carry out most jobs around the home.

Includes:
- Side cutters • Long nose pliers
- 6 Jeweller screwdrivers • Tweezers
- Handle plus extension bar
- 4 Sockets, 7, 8, 9 & 10mm
- 9 bits, 2 Phillips, 2 Slotted and 5 star. All housed in a rugged plastic fold up case.

T 2170 ~~RRP $20.00~~ **$15**

Communication Headset

This lightweight headset features a super sensitive dynamic microphone and a a set of stereo earphones, making it suitable for talkback, fold back or paging systems.

Features:
- Soft cushion vinyl earpads • 6.35mm jack plug
- 200 ohm dynamic microphone
- 30Hz - 12kHz frequency response • -86dB @ 1kHz
- Flexible microphone boom

C 9056A ~~RRP $59.95~~ **$49**

1 GHz Frequency Counter

This multiple-function counter covers a range of 10Hz to 1GHz. It includes an eight digit, seven segment, LED display, low power consumption circuit design, small size, light weight, highly stabilised crystal oscillator for accurate measurement and full input signal conditioning. BNC input connectors.

Q 1536 ~~RRP $525.00~~ **$425**

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A fully up to date reference guide to transistors, diodes, IC's etc.
B 1266 - Volume 1 A-Z
B 1271 - Volume 2 1N-60000µ

Infra-*Red* Mouse

Install this IR mouse and be free of tangled leads!

LIMITED STOCKS

Features:
- Cable-free
- Simple to install
- Compact IR receiver
- Scroll wheels (Up/Down & Left/Right) • Wide (160°) operating angle
- Selectable third button control
- Automatic battery save mode
- Complete with driver software
- Microsoft Windows® 98 2.1/NT 95/98 compatible
- Powered from AA batteries

D 2065 ~~RRP $49.95~~ **$35**

Thunderous Bass

Building your own Hi - Fi subwoofer couldn't be simpler. Build your box around the drivers you choose & enhance it with this 150W Active subwoofer

A 2450 Features:
- Auto Power On/Off with signal presence
- Compact design • High & Low Level Inputs
- High Level Outputs • Volume Control
- Short Circuit Output Protection
- Active Crossover variable from 50Hz - 150Hz • Phase Correction Switch
- Power On Indicator • 240V Operation

A 2450 ~~RRP $299~~ **$209** **Save $80**

Polypropylene Woofers

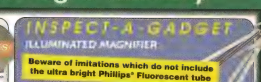
Perfect for Hi-Fi or PA use. Build your own subwoofers!

C 3065 60W 10" Woofer ~~RRP $99.95~~ **$50**

C 3070 150W 12" Woofer ~~RRP $149.95~~ **$69**

INSPECT-A-GADGET

ILLUMINATED MAGNIFIER



Beware of imitations which do not include the ultra bright Phillips® Fluorescent tube

A 0970A ~~RRP $149.00~~ **$119**

19 Range Multi-Function DMM

This 19 range multimeter is so versatile that almost anyone will have a use for it! This unit will measure temperature, light, humidity, SPL, DC volts, AC volts, resistance, transistors & continuity

Incredible 3 year warranty

Features:
- Manual override of auto-ranging
- Range hold & data hold
- 1300 °C Temperature range
- AC < 400mV - 600V
- DC Volts < 400mV -600V
- Resistance < 400Ω - 40MΩ
- Continuity buzzer
- Transistor tester
- Diode check
- SPL 35 dB to 100dB
- 200 Lux to 2000 Lux
- 25% - 95% relative humidity range

Q 1140 ~~RRP $99.95~~ **$85**

NEW KIT PROJECTS FOR 2001

PIC Programmer Kit

(Labtronics) An expanded version of the popular original PIC fun project

This new version features revised software & multi-usage component slots.

K 9602 ~~RRP $59.95~~ **$49**

DC Powerpack Kit

(SC April '01) Turn a single voltage plug pack or car cigarette lighter socket into a multi voltage power supply.

K 3230 ~~RRP $69.95~~ **$59**

Fast Charger Kit

(SC June / July '01) A multipurpose fast charger to charge NiCAD, lithium ion, SLA and 6 & 12V batteries in a flash.

Features: • Time out & fuse protection • NiCad refresh • 240V operation

K 1672 ~~RRP $249.95~~ **$229**

Sub Bass Display

(SC Feb '01) Displays the level of the bass emitting from your car subwoofer or home theatre.

Features: • Four frequency bands, • 12V-15V DC operation

K 6416 ~~RRP $59.95~~ **$49**

Stereo Mini Amp

(SC April '01) Ideal as an amplifier for your PC. This 18W 12V amplifier comes complete with volume, bass and treble controls. Powered from a 12V DC source.

K 6100 ~~RRP $99.95~~ **$94**

Heart Monitor Kit

(SC July '01) Get the best out of exercise. Monitor your heart rate while exercising. *Features:*
- Exercise timer with alarm
- Pulse indicator • Max/Min pulse rate settings

K 8050 ~~RRP $69.95~~ **$64**

Minimitter

(SC April '01) A mini FM transmitter capable of transmitting a stereo source up to 40m under ideal conditions

K 1125 ~~RRP $49.95~~ **$39**

4 Way Camera Switcher Kit

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A high performance colour scope in a shoebox

Here's a machine that many engineers and technicians would kill for: a four channel 100MHz scope with a VGA colour liquid crystal display, inbuilt disk drive, parallel printer port and a host of measurement facilities and it all fits into a case the size of a shoebox!

Review by LEO SIMPSON

Tektronix TDS 3014 four channel colour oscilloscope

For a number of years now we have been using a Tektronix TDS 360 1GS/s 200MHz digital scope for most of our measurements.

You would have seen the scope traces published regularly in the pages of SILICON CHIP. We have really liked that scope for its combination of performance and features and at the time of purchase, we considered it the best overall value for our application.

Tektronix have moved on quite a way since producing the TDS 320/340/360 series and their low-end scopes are now compact instruments featuring liquid crystal displays. In view of this, we decided to have a look at what is perhaps their benchmark instrument in the TDS 3000 colour range, the model TDS 3014. This is a four-channel scope with a 100MHz bandwidth and a maximum sampling rate of 1.25 Gigasamples/second.

Our review sample was also fitted with the TDS 3TRG advanced trigger module and the TDS 3FFT (Fast Fourier Transform) module to give measurements in the frequency domain (ie, spectrum analysis). So all up, this is a high performance combination in a pretty compact package.

In fact, if you are familiar with the typical digital oscilloscope of just a few years ago, you will know that they are fairly bulky instruments. For example, the TDS 360 model referred to above has an overall depth of about 470mm, not including the handle. By contrast, the model TDS 3014 has roughly the same width and height (just a little more) but its depth is only 145mm. In other words, it is about the size of a shoebox (albeit a pretty expensive one!)

In regard to weight, the model TDS 360 tips the scales at about 7kg while the TDS 3014 is half that, at about 3.5kg, making it highly portable.

So not only is the new model half the weight, it takes up only a fraction of the bench space required for the old model. In most applications, that is a very important advantage.

Digital phosphor oscilloscope

As far as Tektronix is concerned, the big feature of the TDS 3000 series is the colour VGA liquid crystal display and you have to agree that compared to the conventional green monochrome CRT, the colour screen is a big advance, particularly when you have up to four (or more) traces on screen.

Each trace has a different colour and with the addition of the Math function trace, you can have up to five different coloured traces on screen: Channel 1, yellow; Channel 2, cyan (blue); Channel 3, magenta (pinky/purple); Channel 4, green; and Math, red. In addition you can also display up to four REF waveforms and these are all shown in monochrome (ie, white).

To see how busy the screen can be with the maximum number of traces displayed, have a look at Fig.1. Trying to examine a mono screen with all those signals would be impossible. Mind you, you can select monochrome for all traces instead of colour but why anyone would want to do that escapes us. Maybe if you are colour blind?

Some readers may be wondering why Tektronix refer to this range of scopes as DPOs which stands for "Digital Phosphor Oscilloscope". This refers to the Tektronix method of intensity modulation which imitates the screen phosphor of an analog CRT (cathode ray tube) oscilloscope. Areas where the signal is concentrated (as in an

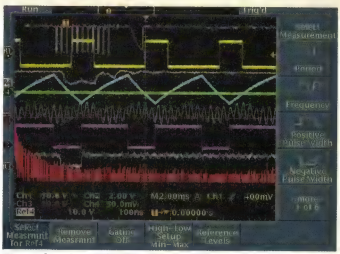


Fig.1: This shows the capability of the VGA (640 x 480 pixels) display to show a lot of waveforms on the screen. In this case we have the four channels, a MATH waveform (in red) and four REF waveforms (in white).

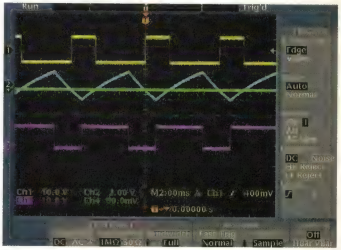


Fig.2: For easy setup of scope parameters, go to the QuickMenu. This displays and allows you set Vertical, Acquire, Cursors and Trigger parameters.

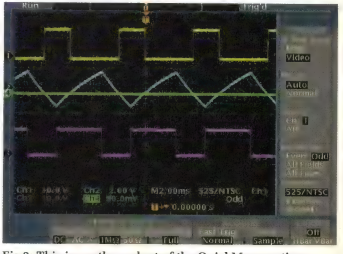


Fig.3: This is another subset of the QuickMenu options, showing the Video triggering options. (Yes, we know those aren't video signals).

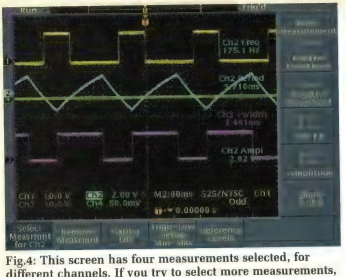


Fig.4: This screen has four measurements selected, for different channels. If you try to select more measurements, the scope will throw up a message on the screen telling you to remove a measurement before you can select another.

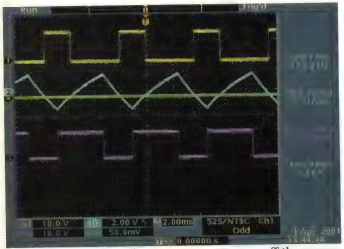


Fig.5: Once you clear the measurement menu off the screen (by pushing the Menu Off button) the four measurements are then displayed to the right of the screen and do not clutter the waveforms.

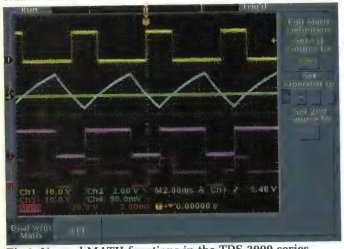


Fig.6: Normal MATH functions in the TDS 3000 series allow you to add, subtract, multiply or divide any two channel signals together, or any combination of the input channels with any of four stored reference signals. This screen shows the MATHematics trace in red, as the sum of channels 1 and 3.

amplitude-modulated RF signal) appear the brightest and areas where the signal is moving fastest (ie, rising and falling edges of pulses) appear dimmer.

While we don't particularly like the Tektronix DPO label for this technology, it is a big advance on previous digital scopes and gives a more realistic (ie, analog) picture of the signal you are measuring.

Having said that, you can vary the degree of intensity modulation on the waveforms by using the "Waveform Intensity" knob on the righthand side of the control panel. Also, the REF and Math waveforms are constant brightness; ie, no intensity modulation is used. You should be able to see this effect in Fig.1.

Before we leave the subject of the colour screen, we thought that it would have been nice if the probes had matching colour rings to identify them. On our review machine, they were supplied with red, white, orange and black rings. Why not make them available in the four colours displayed on the screen traces? This would also match the channel selector buttons on the control panel. I contacted Tektronix and suggested it. Guess what: current production models have the probe rings matching the channel colours.

Ease of use

Two things we particularly liked about the TDS 360 were the ease of use, in getting a waveform on the screen and then varying all the display parameters, and then selecting a whole range of measurements of which four can be displayed on the screen at any time. The TDS 3000 series is even better in this respect, particularly in respect to its "QuickMenu" button. As before, you can connect any or all of the four channels to signals and press the "Autoset" button to set the timebase and vertical sensitivity on each channel to display a useable trace. At the same time, the scope triggering selects the lowest active channel as the source, usually Channel 1.

From there you can go in and change the vertical, horizontal (timebase) and trigger settings and a bunch of other features to get the scope display you want. But doing all of that would normally require quite a few button presses. On the TDS 3000 series, you can bypass a lot of those steps by pressing the QuickMenu button; it displays a whole lot of scope settings, as shown in Fig.2.

Note that the vertical sensitivity for all active channels is always shown at the bottom of the screen and again, the colours match the traces. Also shown are the timebase setting, the channel selected for triggering (Channel 1, in this case), the trigger slope, trigger level and trigger time reference.

QuickMenu information is displayed below and to the right of the screen graticule. At the bottom are the vertical input conditions for the selected channel (Channel 3, in this case), the Acquire settings and Cursors (Off, Vertical or Horizontal). Trigger settings are shown to the right of the screen, in five separate boxes: Trigger type (edge or video), Trigger mode, Trigger source (channel 1, 2, 3 or 4, Alternate or AC line), Trigger Coupling (DC, Noise reject, HF reject or LF reject) and Trigger slope.

Note that each one of the displayed QuickMenu settings can be changed by pushing the adjacent button (below or to the right of the screen; you do not have to go back to the individual menus to make these changes.

Note also that if you select Video triggering from the QuickMenu display, it all changes, as shown in Fig.3. You then have the choice of Video standard (NTSC, PAL or SECAM) and field or line triggering (Even, Odd or All fields or All lines). Yes, we know that Fig.3 doesn't show video waveforms but we got lazy for this screen grab. By the way, the waveforms shown in Figs.1, 2 and 3 are from the Li'l Pulser switchmode train controller published in the February 2001 issue of SILICON CHIP.

I should note that on our review sample, if you press the Trigger menu button, you have more options apart from Edge and Video triggering: Logic and Pulse triggering and all the associated parameters. These are the additional features of the Advanced Triggering Module. For example, if you go for pulse triggering, you can select width, runt and slew rate, with the latter set to ECL, TTL or adjustable high and low thresholds. That's pretty comprehensive.

Measurements

Where the Tektronix TDS 3000 series really shine is in the Measurement department. Not only is there a host of different measurements but they do not interfere with the waveform display. Some other scopes we have seen throw up cursors whenever you select an amplitude or frequency-related measurement and those cursors ride on the waveform while ever the measurement is displayed - annoying.

In all, 21 different measurements are available, including Frequency, Period, Rise & Fall Time, Positive & Negative Duty Cycle, Positive & Negative Overshoot, Peak-Peak, Amplitude, Mean, RMS and so on. Only four measurements can be displayed at a time and they can all relate to one selected channel or to all four channels (but still only four measurements can be displayed).

As you select each measurement for a designated channel it is displayed on the righthand side of the screen. Fig.4 shows a screen with four measurements selected, for different channels. If you try to select more measurements, the scope will throw up a message on the screen telling you to remove a measurement before you can select another.

A good feature is that once you clear the measurement menu off the screen (by pushing the Menu Off button) the four measurements are then displayed to the right of the screen and do not clutter the waveforms. Fig.5 shows the result. This is particularly important if you want to save the screen waveforms to a monochrome printer – you do not want measurements printing over waveforms.

Again, notice that the displayed measurements are in the same colours as the designated channel. This is just one of the little niceties that you get with a colour display.

We mentioned printing the waveforms and the TDS 3000 series come standard with a parallel printer port and a whole bunch of inbuilt generic printer drivers. Normally though, connecting a printer is too much of a hassle and most users would probably prefer to save the printer files to the floppy disk drive for printing later on. Of course, we take the scope files and include them in our published articles. But just how do you go through the process? Well, it ain't intuitive, that's for sure! And it is not at all obvious even after reading the relevant sections of the manual, under the heading "Save/Recall".

We did manage to do it, as is evidenced by the waveforms in this article. What you don't do is to push the Save/

Fig.7: This screen shows the FFT trace (red) when channel ? is selected for analysis. You can set the vertical scale to linear or dbV RMS and the FFT window to Hamming, Blackman-Harris, Hanning or Rectangular.

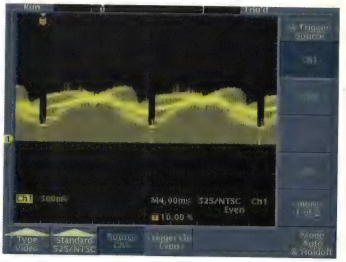


Fig.8: This NTSC video waveform is a good illustration of the intensity modulation of the VGA display. This is every bit as good as the equivalent screen on an analog scope with a conventional CRT.

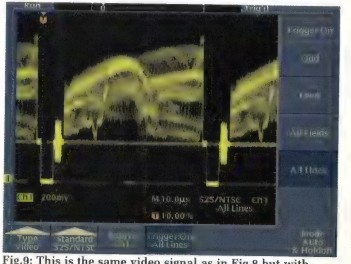


Fig.9: This is the same video signal as in Fig.8 but with triggering on all lines of the signal.

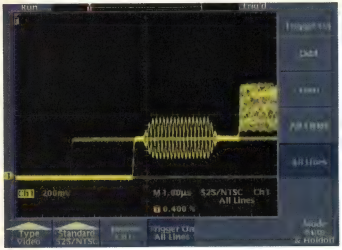


Fig.10: Winding the timebase up to 1µs/div lets you view the colour burst of the video signal in Fig.9.

Recall button. This will certainly read the directory of any disk that happens to be in the drive but you will go red in the face trying to save screen grabs to it. You can save and recall waveforms, either to internal memory or the disk but that is entirely another matter.

No, what you have to do is press the Utility button and then cycle through the screen menus to bring up Hard Copy. You then press Port Centronics and change it to Port File (Aaah!).

But that's not the end of the story. You then have to choose the Hard Copy format and you have 16 options, ranging from mono and colour inkjet printers, laser or dot matrix printers and files in formats such as TIFF, EPS, BMP, PCX, IMG and so on. And you can also choose Landscape or Portrait orientation for your printouts.

OK, so we chose TIFF format. What to do then? It had us really tricked. Finally, the light went on and I pressed the Printer button on the lefthand side of the screen and the disk drive started whirring merrily away. As Homer Simpson often exclaims, "Doh!". I suppose it should have been obvious but it wasn't.

Of course, as with the previous model TDS 360, once you set these things up, you seldom have any reason to change them and it can be really hard to figure out how you did it.

And finally, as an embarrassing footnote to my detective work, I then found the disk save procedure a couple of nights later, clearly outlined on page 3-21 of the instruction manual, under the heading "Hard Copy". Yes, I know, I know: read the instruction manual!

Maths functions

Normal MATH functions in the TDS 3000 series allow you to add, subtract, multiply or divide any two channel signals together, or any combination of the input channels with any of four stored reference signals. Fig.6 shows the MATHematics trace in red, as the sum of channels 1 and 3.

Our sample machine also had the FFT module fitted so you can do an FFT (Fast Fourier Transform) analysis on any of the four channels or any of the stored REF signals. Typically, the bandwidth of the FFT is limited by the timebase setting. The same comment applies to the sampling rate. The maximum sampling rate is only available for timebase speeds of 1µs/div and above.

Fig.7 shows the FFT trace (red) when channel 1 is selected for analysis. You can set the vertical scale to linear or dbV RMS and the FFT window to Hamming, Blackman-Harris, Hanning or Rectangular.

Video waveforms

Finally, a demonstration of the TDS 3014's performance on video waveforms. Fig.8 shows an NTSC video waveform and is a good illustration of the intensity modulation of the VGA display.

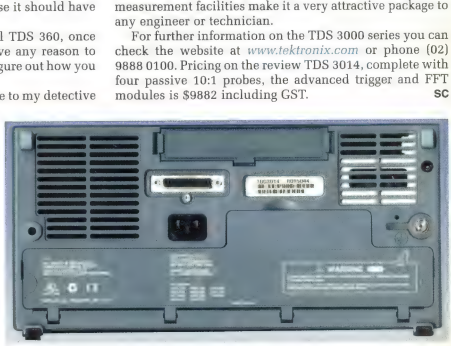
Fig.9 shows its performance when triggering on all lines of the signal. The triggering is effective enough to easily examine the waveform but not quite stable enough to allow reliable measurements such as frequency. To do that, you would need the line triggering feature in the optional video triggering module.

Fig.10 shows the timebase wound up to 1µs/div to display the colour burst.

Summary

As with any review of a complex digital oscilloscope it is just not possible to do full justice to all its features in a few pages. However, having used it for a few weeks, we can see why it is one of the best selling Tektronix scopes ever. Its combination of compact size, light weight, colour display and 100MHz 4-channel performance plus exellent measurement facilities make it a very attractive package to any engineer or technician.

For further information on the TDS 3000 series you can check the website at *www.tektronix.com* or phone (02) 9888 0100. Pricing on the review TDS 3014, complete with four passive 10:1 probes, the advanced trigger and FFT modules is $9882 including GST. **SC**



At the rear of the TDS 3014 is the standard parallel port and a compartment for the optional battery pack. When this option is not used, the compartment is handy for storing a couple of probes.

PrismSound dScope Series III Audio Test System

The dScope Series III is a complete audio system which works in both the digital and analog domains. Its inbuilt generator produces a wide range of analog and digital test signals and its analyser then produces a performance analysis of the equipment under test.

The big advance of the dScope is that it is completely under the control of your PC, using either Windows 2000 or Windows 98. In fact, clicking on the dScope shortcut even turns the machine on!

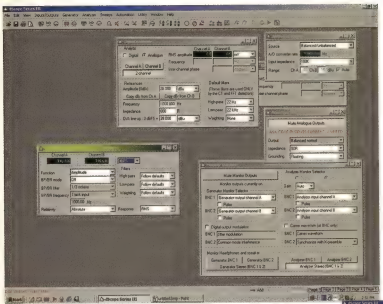
Our previous experience with complete audio analysers has been largely confined to our own Audio Precision test set although we are briefly familiar with the notable Tektronix 700 audio analyser. Our Audio Precision machine is DOS-controlled although Windows upgrades are available. However, the dScope is the most completely Windows-controlled audio test set we have come across.

Another big advantage over the esteemed Audio Precision test set is that the dScope does not require a large custom card to be installed in the PC which for the AP set means that it is permanently tethered to one particular PC. Instead, the dScope links to any PC, laptop or whatever, via a USB (Universal Serial Bus) cable. That means you can use it with any machine that has the software loaded.

Hardware required is a Pentium 200 (or above) PC or laptop with 24MB of free memory, running Windows 98 or 2000, CD-ROM drive and USB port. The software comes on CD-ROM and auto-runs as soon as you slot it into the drive (provided you have auto-play enabled). Once the software is loaded, you can start the machine just by clicking on the desktop short-cut.

The machine itself is quite compact and has seven XLR sockets on the front panel, for the Generator and Analyser inputs and outputs.

As well, there are BNC sockets for unbalanced inputs and outputs and for monitor (external oscilloscope, AC millivoltmeter, etc) outputs. Optical (TOS) sockets are also provided for the digital inputs and outputs. There is also a headphone socket and volume control, for monitoring the signals.



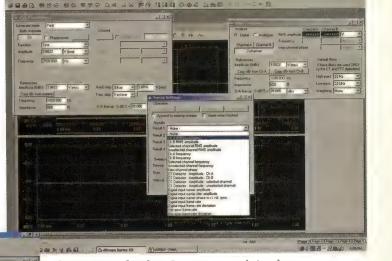
Setting up the dScope is done under Windows. A separate window is opened for each function. In this case there are six windows displayed, with the active window having a green title bar.

While the software is claimed to be intuitive (the same claim is made for virtually all Windows software), we found that there is quite a learning curve as you build familiarity with all the operating features. Most of these are brought into play by the toolbar at the top of the screen or in the various windows brought up as you select a feature or operating mode. These toolbars are quite complex and we found all the little symbols anything but intuitive at first – "inscrutable" would be a better word.

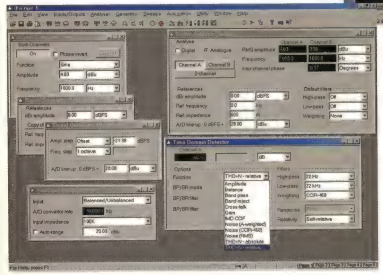
However, perseverance pays off and you soon begin to appreciate how all the parameters and operating modes can be easily varied from the various windows. We have taken some screen grabs to demonstrate some of the operations.

Apart from being entirely controlled under Windows (the only panel control is the headphone volume knob), the Prism dScope is a highly specced audio test set. Its analog audio generator operates from 1Hz to 86kHz. THD + noise over the range from 20Hz to 20kHz (for sinewaves) is -105dB (<.0006%). Output waveforms can be sinewave, square, ramp, burst, white noise, pink noise, MLS, pulse, twin-tone and arbitrary.

The digital generator can produce the same waveforms as the analog with frequency range from 1Hz to 96kHz (fs/2). Dither is applied as white TPDF or plain truncation. DC resolution is 48 bits. A large range of digital carriers are supported, including AES3(XLR), S/PDIF and TOS (optical).



dScope can display Generator and Analyser waveforms and again, the timebase and other settings are controlled by opening separate windows.



dScope can operate in both the frequency and time domain, as indicated by this screen which has a window for the time domain detector. The drops down menu shows some of the measurements which can be made.

On the analyser side, the analog amplitude range is large, ranging from the residual noise of 1.1µV up to the maximum peak input of 159V RMS (-116dBu to +46dBu; ie, referred to 1mW into 600Ω). Residual THD + noise for 20Hz to 20kHz is -108dB (.0004%).

As you would expect, both the analog and digital analysers fully complement the analog and digital generators and the whole system can fully check both channels of a stereo system, driving both channels simultaneously, in balanced or unbalanced mode.

All in all, the Prism dScope Series III is a very impressive instrument. Further technical information can be obtained from the PrismSound website at www.prismsound.com

The Australian distributor for PrismSound products is Control Devices, 1/150 William Street, East Sydney, NSW 2011. Phone (02) 9356 1943. **SC**

PRODUCT SHOWCASE

Branded PC cards from DSE

There are literally thousands of PC upgrade cards available out there. But do you know what you're getting? For the most part, they're either unbranded or carry a very obscure brand. Trying to buy another card the same as one you like can be daunting, if not impossible!

Dick Smith Electronics have decided to change that by introducing a range of name-branded cards. Prominent in the USA, the "Dolphin" cards are new to the Australian market and are exclusive to DSE.

They range from standard parallel and serial ISA and PCI cards through network cards to advanced USB and Firewire PCI cards. While intended for self-installation, DSE can also supply local installer details or do it for you at a DSE Power-House 'Computer Upgrade Centre'.

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Dick Smith Electronics
100 Silverwater Rd, Silverwater NSW 2128
Phone: (02) 9741 8555
Fax (02) 9741 8500
Website: www.jaycar.com.au

SMD R-G-B point-source LEDs

A new line of point-source red-green-blue surface-mount LED pixels have been released by Lumex (USA).

These appear as full-colour point sources to the human eye and are able to generate any mix of the three primary colours. They're idea for high-end indoor and outdoor signage, full-colour video displays or anywhere multi-colour lights are needed in strips or clusters.

There are three individually-addressable chips (R,G,B) in each SMD package. Built-in reflectors and/or lenses combine the output to what appears to be a point-source pixel, even at just 10cm away.

Contact:
Lumex Inc
290 E Helen Rd, Palatine, Il 60067 USA
Phone: (0011) 1 847 2790
Website: www.lumex.com

Double-insulated DMM from Jaycar

Jaycar Electronics has released a new, auto-ranging Digital Multimeter that is designed to IEC1010 specifications. The unit is double insulated and can be used on 600V category III and 1000V category II installations at voltages up to 750AC and 1000V DC (relative to earth).

The meter, Cat QM-1540, has an attractive modern styling and features Auto Power Off, Data Hold, Relative Measurement, Frequency and an audible overload warning as well as the normal Voltage, Current, Resistance and Capacitance ranges.

Recommended retail price is $89.95 For more information, contact your nearest Jaycar store or visit the Jaycar website.

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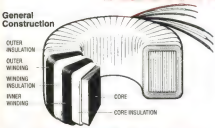

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EasyJack turns a power point into a phone socket

With computer users needing close-by phone line sockets for Internet access, a new product released by Smart Connect is sure to find a ready market.

It's a device which allows phone signals to be sent around the home or office via existing 240V wiring. Called EasyJack, the Austel-approved system has a "base unit" which is plugged into any existing phone outlet and 240V outlet. An extension unit can then be plugged into any power outlet and any phone device, whether an actual phone, a modem, fax machine, etc, can simply be plugged into that extension unit.

Suggested retail price will be around $239, which is similar to the retail price of the unit in the USA. Sold under various well-known brands, it has been on the US market for four years and has been popular with both home and business users. It is being marketed to retailers in Australia by Brilliant Marketing.

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VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

How to repair Bakelite cabinets

Up till now, restoring a valve radio set with a broken Bakelite cabinet was regarded by most people as a lost cause. Bakelite is a very brittle material and is hard to glue satisfactorily. Right? Wrong! Read how it can be done.

What an absolute shame it is when the inside of the set is in good condition but the cabinet is broken. How many sets are there that cannot be restored due to a broken case? How many have been consigned to the rubbish heap because what was once a beautiful cabinet is now a pile of broken junk? The value of a set with a broken cabinet (or dial scale) is almost nil.

Wouldn't it be wonderful if the cabinet from a Bakelite radio could be repaired and made to look like it did when it was first sold? Too right – you say – but it can't. Well I thought so too – they were beyond redemption if extensively damaged.

Photo 1: normally, you would not consider restoring this sorry looking mess. The cabinet looks well beyond redemption.

However, a fellow member of the local vintage radio club, Ralph Robertson, has shown that even badly broken cabinets can be effectively repaired.

Each collector cum restorer has his or her particular area(s) of expertise and one of Ralph's is the restoration of Bakelite cabinets. Many fine examples of his art are displayed in his collection.

For the purposes of this story, I applied his methods to an STC A-141 mantle set with a badly broken cabinet. This is the same make and model as the set featured in last month's article. In fact, if you have a good look at the photos in last month's article, you will see that it is the same set! We'll bet that few readers noticed that the cabinet had been extensively repaired.

Repairing the cabinet

I've taken nine photos to demonstrate the stages of this repair and as you can see, it is a real wreck to begin with. In fact, the cabinet would normally have been consigned to the garbage bin.

Basically the cabinet was in two halves, with the grille in several pieces and unfortunately some pieces were missing. Photos 1 & 2 show the wreck. As well, there was a chunk missing out of the top at the back. Having looked at this disaster it was time to start the restoration. Before you start, make sure you keep all the parts in a box so that none get lost.

The first step is to thoroughly clean all the pieces of the cabinet. Clean, warm, soapy (kitchen detergent) water with cloudy ammonia in a ratio of about 9:1 is used with a scrubbing brush and an old toothbrush to get all the gunk off. Rinse each piece under cold water until it is clean.

Small cracks need to be slightly prised apart and a pin or similar item slipped into each crack so that it can be cleaned to the best of your ability. The toothbrush is the best item for thoroughly cleaning out the cracks or any of the cracked surfaces. Glue will not adhere through dirt and grime, so it is imperative to be very thorough.

Now the job of gluing the cabinet together is undertaken. While the method to be described is not suitable in all cases, it will be a good starting point and restorers can adapt the method to individual cabinets.

Photo 3 shows the cabinet and the bits necessary to hold it together as the glue hardens. You need a length of cord and a large rubber band cut out of an old car or bicycle inner tube. Get one from your favourite tyre store. The cord is tied to the rubber band as shown and the cord and band are wrapped around the cabinet to be glued. The cord is attached to the other side of the rubber band and its length adjusted so that reasonable tension is applied via the rubber band to keep the cabinet firmly together. It is removed after the glue hardens.

Have a trial run with the rubber band setup before applying the glue to the broken edges of the cabinet.

Having worked out how you will hold the cabinet together, dismantle the cord and rubber band and start the gluing process. Apply a bead of Araldite (TM) along the surfaces to be joined so that the glue is not proud on the outside surface of the cabinet, if at all possible. It dries a different colour to the cabinet and will show up as a visible line.

Surplus Araldite can be wiped off with a cloth moistened with acetone. On the inside it doesn't matter. This is not always an easy task as it is gooey and seems to go everywhere except where you want it and, of course, there is limited time to do the job.

I've normally used 5-minute Araldite but with the rubber strap employed, the longer setting version could be used. If you have any doubts about the freshness of your Araldite, open a new batch. Leave the glue to harden over several hours with the holding strap on. Then take the strap off and check your progress so far.

It is best to glue only one section at a time and leave just a small gap in the other surface to be joined as shown in the photograph. A couple of matches will keep the second break apart. The Bakelite tends to distort when broken, so by doing the repair one surface at a time it is possible to align them more accurately and get a stronger join.

Photo 2: the job looks even worse with broken pieces of the cabinet spread out.

Photo 3: during gluing, the cabinet is held under tension by a cord and rubber band arrangement while the Araldite sets. Only do one join at a time.

Small cracks can be prised apart and a pin fitted to allow the glue to penetrate, as shown in photo 3 – in this case, above where the dial scale fits. Remove the pin as soon as the glue has filled the space.

I have had some problems with the Araldite not having as much strength as expected. To get the maximum strength, mix the two components thoroughly, stirring them until the mixture goes milky. Continue mixing

Photo 4: ice-cream sticks were shaped and glued into the speaker grille gaps. Don't laugh, the end result is effective.

until the mixture again becomes clear, then apply it to the joins. The joins are now reasonably strong although not as strong as the areas where no breaks had occurred.

The speaker grille in this cabinet was a real mess, looking a bit like a fighter who had most of his teeth knocked out. There were some pieces still with the cabinet and these were glued back into place with Araldite. The cabinet was stood on end so that the weight of the grille pieces would not cause them to move as the glue set; a messy job.

Next, it was necessary to make some more grille pieces and in this case ice-cream sticks made almost ideal replacements. These were slightly shaped and cut to length, then glued into place – see photo 4. Using a small needle-nosed file it is possible to file away the excess glue once it has well and truly set.

Painting the grille

The ice-cream stick grille can now be painted. Before doing so, clean the area to be painted with methylated spirits. The ideal paint is oil-based, with a satin finish. This is not always possible to obtain in small tins. I had some black matt and some mission brown gloss enamel which I mixed together. It was only necessary to add a very small amount of black to the brown to get a reasonable match to the colour of the cabinet.

With a small artist's brush, paint the ice-cream sticks and let them dry. There was a small amount of excess glue in a corner near the grille which I couldn't remove, so I also painted this to keep the cabinet a reasonably uniform colour.

Once the paint is dry, use a small fine-toothed file to file down the irregularities in the paint finish. Paint and file around three times but don't file or sand the last coat of paint. The finish will now look almost identical to the original Bakelite.

Strengthening the cabinet

The next step is to strengthen the cabinet as the glue bond is not over the whole of the broken edges and hence is not as strong as the rest of the cabinet.

Fibreglass matting and general purpose polyester resin are used to strengthen the joins. On the inside of the cabinet where the breaks were, chip away the excess Araldite with a knife or wood chisel. With 800 grade or similar wet and dry paper, sand along the glue joins for about a centimetre either side of the joins, then clean up with methylated spirits.

The full list of materials and tools used for the strengthening of the cabinet are general purpose polyester resin, catalyst hardener, fibreglass matting, pigment to suit the colour of the cabinet, acetone and a small stiff-bristled brush. The resin may be available in tins as small as 250ml and the hardener is usually available in bottles of around 30 to 50ml. Pigment comes in 50ml bottles or larger (you'll use very little of it).

Fibreglass matting is available in a variety of widths and density and a suitable type is shown in the photographs. Acetone is available in tins from around 250ml. Brushes and other materials are usually available from hardware stores. Alternatively, check with organisations that deal exclusively with fibreglass materials.

The pigments are the hardest to obtain and may need to be ordered in. Dark brown is a good colour to start with but red and black may be necessary as well, as the exact colour may need to be made by mixing various colours.

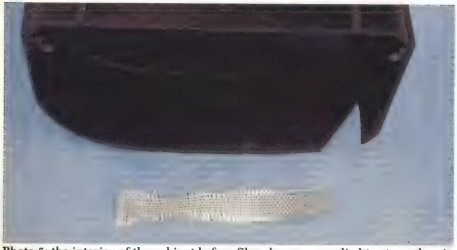

Photo 5: the interior of the cabinet before fibreglass was applied to strengthen it. A strip of fibreglass matting is shown in the foreground.

Photo 6: the missing section of the cabinet was replaced with resin applied to a strip of celluloid or acetate. The materials used in the repair are shown alongside it, less the fibreglass matting.

To match the colour of the Bakelite, put a small amount of the pigment on an inconspicuous part of the cabinet so that you can carefully compare the two. By adding red and/or black it should be possible to match most dark Bakelites. If you have trouble obtaining the materials locally, it could be worthwhile contacting Solid Solutions, 19 Ardena Court, Bentleigh, Vic 3204. Phone (03) 9579 2044.

We are now at the stage of strengthening the cabinet. Cut a small strip of fibreglass matting around 20mm wide, as shown in photo 5, to match the length of the repaired crack. Pour one or two teaspoons of resin into a 35mm plastic film canister, then add around five drops of hardener and mix it well. Do not use too much catalyst/hardener as it will cause the polyester resin to shrink. A 1% hardener by weight ratio equals one drop per five grams of resin. A 2% hardener by weight ratio equals two drops per five grams of resin and so on. The 1% mixture has a pot life of around 30 minutes and the 2% mixture around 15 minutes at 25°C.

With a small stiff-bristled paintbrush, brush the mixture onto the sanded-down area along the glued joint, then place the matting along the joins. Put more resin onto the matting, working it into the matting by dabbing with the paintbrush so that it is thoroughly saturated with resin. The fibreglass can be pushed around to get it exactly where you want it. Then leave it to set.

Clean the brush and the film canister container with acetone. The resin does not stick to the plastic. Further coats of resin can be put over the original coats and sanded so that an extremely smooth finish is obtained. The sanded area of the resin goes white but when another coat is applied, it reverts to the colour of the resin or if it has been pigmented, to the colour of the pigment.

Plastic surgery

That is the easy part. The next stage is the replacement of the missing bit of the cabinet. Obtain an acetate (celluloid) sheet from an art material supplier. The sheets are around 600mm square. Alternatively, you can use celluloid from a shirt box, or similar. Cut a piece just a bit bigger than the piece of cabinet that is missing.

Attach it over the missing bit of the cabinet with masking tape – see photo 6. This photo also shows the materials needed to do the repairs.

Fortunately this is a simple curve, so the sheet will follow it without problems. However, be quite careful in ensuring that the acetate sheet follows the curve precisely and is flush with the Bakelite that it is attached to. If it isn't, the resin will seep between the acetate sheet and the Bakelite and give a step in the finish where the resin and the Bakelite butt up to one another. The resin will not adhere to the sheet.

Where curves are complex, a Plaster of Paris mould would need to be made. I won't go into how to do complex curves in this article – let's just get a simple one right.

Matching the pigment

The next step is to match the pigment with the colour of the Bakelite, by mixing various colours until the right colour is obtained. For most dark Bakelites a mixture of dark brown, black and red will usually achieve a good match. Some fibreglass outlets will mix pigments for a reasonable cost and this may be better than buying several tins or bottles of pigment.

I didn't have quite the correct colour pigment as can be seen in photo 7; my next cabinet repair will be better. This is then mixed into the next batch of resin and hardener used. This is

Photo 7: the rough edges of the fibre-glassed repaired cabinet section need to be sanded until they are smooth.

Photo 8: this is how the repaired cabinet looked before the final cut and polish.

painted onto the underside of the acetate sheet. Once this has set, put another pigmented layer on.

Now cut a piece of fibreglass mat to overfill the broken section. Brush on another coat of resin, then lay the mat over the gap and overlap by about a centimetre onto the Bakelite either side of the gap. While it is still workable, put more resin onto the mat, making sure it is saturated. Use the paintbrush to dab at the matting, forcing the resin through any holes, thereby eliminating any air bubbles. Dabbing also eliminates any brush "drag".

Allow to set, then place another fibreglass mat into the gap and do the same as for the first mat. Perhaps use a little less hardener so that the setting time is extended. If quite an area is to be built up, talcum powder can be used as a filler.

Once the resin has set, sand it so that it is reasonably smooth. Cut off any strands of fibreglass mat that protrude from the resin and clean the sanded material off. Coloured pigment can be added to the next coat but is not essential on the inside of the cabinet as the colour of the Bakelite still shows through. The last coat of resin will have pigment added to it to make sure the matting under it is completely disguised. Several layers of resin and fibreglass are applied until the material is around the same thickness as the Bakelite.

The edge of the resin and fibreglass along the rear edge of the cabinet was then sanded until it was straight and smooth. Photo 7 shows the cabinet with the acetate removed and ready to be sanded. Another light coat of resin is applied to the back edge so that it is virtually the same colour as the rest of the cabinet.

Repairing the cabinet exterior

It is likely that there will be a few bubbles in the glue on the outside surface of the cabinet. To get rid of these bubbles, use a reasonably fine file and working carefully, file the glue away. Be careful not to file the areas of the cabinet near the glued joint. The glue will file quite nicely and it is possible to get it nearly flush with the cabinet. If the join is perfect there will be no gaps, so the surface will be smooth and continuous with no bumps.

Finish off with fine wet and dry paper (grade 800 - 1200 - 2000). In many cases there will be some small gaps as the Bakelite may have splintered on breaking and have very small pieces missing at the break. It may be necessary to fill these tiny gaps with some coloured resin.

If for some reason the two sections of Bakelite on either side of the join are not level (this happens with some breaks), it is quite practical to use the file (with care) and the wet and dry paper to sand away some of the high side of the join to make it smooth. This is ultimately finished off with automobile cream cut and polish which will make the join hard to see – but not completely invisible. The cabinet looks a million dollars compared to what it looked before restoration.

The next step is to use very fine (grade 800 - 1200 - 2000) wet and dry paper (wet in water) to remove any light scratches. When rubbing, don't go too deep as it will put a dimple in the cabinet. If you can't get a scratch out, try using a spirit-filled colour pen such as a "Texta Colour" to tint the scratch.

Automotive cut and polish can also be used to remove the scratches but if you do use it you may need to use

Photo 9: this is the completed cabinet and receiver after its final polish. It's not perfect but would you have thought that the mess in photo 1 could be restored to this standard?

methylated spirits to get rid of the polish around where the spirit filled pen is to be used. The final polish won't be done until the cabinet is all in one piece.

The final polish

It's been a reasonably long process repairing the cabinet but it is really starting to look great when compared to the sorry heap of bits that we started with.

I have found that car cut and polish is very good for giving a cabinet that last little bit of a lift. Firstly, make sure that there are no obvious scratches. If there are, use the fine wet and dry paper to get these out if you can. Once they are gone and the cabinet is smooth but dull, it is then time to do the cut and polish trick.

Put some cut and polish compound onto a cotton rag and work on a small area of the cabinet, such as the top. Once it is nearly dry, use another cloth and polish the area with a circular motion – or rub the cloth backwards and forwards if there is a groove where you are working. Generally, do the cutting and polishing over the whole cabinet in sections, using the two cloths.

It can then be seen how the cabinet has come up from the above photo.

It may be necessary to do further work on some sections to get all of the oxidised Bakelite off. The original rich Bakelite colour underneath the gunk will now be revealed – and doesn't it look good!

Fingers will mark the finish, so carefully polish the cabinet with a clean rag. Keep your fingers inside the cabinet if possible, to make sure the finish is not marred.

Well, that's about it. The cabinet, while not without some blemishes, is looking good as is shown in photos 8 & 9. The receiver has considerable nostalgic value to the owner and he was thrilled with the end result. What more could I ask!

Summary

The method that I have described in this article is not the only way in which a Bakelite cabinet can be restored. It is a method that can achieve quite satisfying results and save many a set from an unworthy end.

This was the first Bakelite repair job I have done with assistance and encouragement from Ralph Robertson. This shows that with care, you can confidently repair most damaged Bakelite cabinets. **SC**

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March 1994: Intelligent IR Remote Controller; 50W (LM3876) Audio Amplifier Module; Level Crossing Detector For Model Railways; Voice Activated Switch For FM Microphones; Engine Management, Pt.6.

April 1994: Sound & Lights For Model Railway Level Crossings; Discrete Dual Supply Voltage Regulator; Universal Stereo Preamplifier; Digital Water Tank Gauge; Engine Management, Pt.7.

May 1994: Fast Charger For Nicad Batteries; Induction Balance Metal Locator; Multi-Channel Infrared Remote Control; Dual Electronic Dice; Simple Servo Driver Circuits; Engine Management, Pt.8.

June 1994: 200W/350W Motorbike Amplifier Module; A Coolant Level Alarm For Your Car; 80-Metre AM/CW Transmitter For Amateurs; Converting Phono Inputs To Line Inputs; PC-Based Nicad Battery Monitor; Engine Management, Pt.9.

July 1994: Build A 4-Bay Bow-Tie UHF TV Antenna; PreChamp 2-Transistor Preamplifier; Steam Train Whistle & Diesel Horn Simulator; 6V SLA Battery Charger; Electronic Engine Management, Pt.10.

August 1994: High-Power Dimmer For Incandescent Lights; Microprocessor-Controlled Morse Keyer; Dual Diversity Tuner For FM Microphones, Pt.1; Nicad Zapper (For Resurrecting Nicad Batteries); Electronic Engine Management, Pt.11.

September 1994: Automatic Discharger For Nicad Battery Packs; Mini-Vox Voice Operated Relay; Image Intensified Night Viewer; AM Radio For Weather Beacons; Dual Diversity Tuner For FM Microphones, Pt.2; Electronic Engine Management, Pt.12.

October 1994: How Dolby Surround Sound Works; Dual Rail Variable Power Supply; Build A Talking Headlight Reminder; Electronic Ballast For Fluorescent Lights; Electronic Engine Management, Pt.13.

November 1994: Dry Cell Battery Rejuvenator; Novel Alphanumeric Clock; 80-Metre DSB Amateur Transmitter; Twin-Cell Nicad Discharger (See May 1993); How To Plot Patterns On PC Boards.

December 1994: Easy-To-Build Car Digital Alarm; Three-Spot Low Distortion Sinewave Oscillator; Clifford – A Pesky Electronic Cricket; Remote Control System for Models, Pt.1; Index to Vol.7.

January 1995: Sun Tracker For Solar Panels; Battery Saver For Torches; Dolby Pro-Logic Surround Sound Decoder, Pt.2; Dual Channel UHF Remote Control; Stereo Microphone Preamplifier.

February 1995: 50-Watt/Channel Stereo Amplifier Module; Digital Effects Unit For Musicians; 8-Channel Thermometer With LCD Readout; Wide Range Electrostatic Loudspeakers, Pt.1; Oil Change Timer For Cars; Remote Control System For Models, Pt.2.

March 1995: 50 Watt Per Channel Stereo Amplifier, Pt.1; Subcarrier Decoder For FM Receivers; Wide Range Electrostatic Loudspeakers, Pt.2; IR Illuminator For CCD Cameras; Remote Control System For Models, Pt.3; Simple CW Filter.

April 1995: FM Radio Trainer, Pt.1; Photographic Timer For Darkrooms; Balanced Microphone Preamp. & Line Filter; 50WChannel Stereo Amplifier, Pt.2; Wide Range Electrostatic Loudspeakers, Pt.3; 8-Channel Decoder For Radio Remote Control.

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June 1995: Build A Satellite TV Receiver; Train Detector For Model Railways; 1W Audio Amplifier Trainer; Low-Cost Video Security System; Multi-Channel Radio Control Transmitter For Models, Pt.1.

July 1995: Electric Fence Controller; How To Run Two Trains On A Single Track (Incl. Lights & Sound); Setting Up A Satellite TV Ground Station; Build A Reliable Door Minder.

August 1995: Fuel Injector Monitor For Cars; Gain Controlled Microphone Preamp; Audio Lab PC-Controlled Test Instrument, Pt.1; How To Identify IDE Hard Disk Drive Parameters.

September 1995: Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.1; Keypad Combination Lock; The Vader Voice; Jacob's Ladder Display; Audio Lab PC-Controlled Test Instrument, Pt.2.

October 1995: 3-Way Bass Reflex Loudspeaker System; Railpower Mk.2 Walkaround Throttle For Model Railways, Pt.2; Four Cheapo Nicad Batteries; Digital Speedometer & Fuel Gauge For Cars, Pt.1.

November 1995: Mixture Display For Fuel Injected Cars; CB Transverter For The 80M Amateur Band, Pt.1: PIR Movement Detector; Digital Speedometer & Fuel Gauge For Cars, Pt.2.

December 1995: Engine Immobiliser; 5-Band Equaliser; CB Transverter For The 80M Amateur Band, Pt.2; Subwoofer Controller; Knock Sensing In Cars; Index To Volume 8.

January 1996: Surround Sound Mixer & Decoder, Pt.1; Magnetic Card Reader; Build An Automatic Dog Feeder; Controlling The Remote Control For The Railpower Mk.2; Recharging Nicad Batteries For Long Life.

April 1996: Cheap Battery Refills For Mobile Telephones; 125W Audio Power Amplifier Module; Knock Indicator For Leaded Petrol Engines; Multi-Channel Radio Control Transmitter; Pt.3; Cathode Ray Oscilloscopes, Pt.2.

May 1996: Upgrading The CPU In Your PC; High Voltage Insulation Tester; Knightrider Bi-Directional LED Chaser; Parking Buzzer Idea; Using Ultra Probe Optic Cable; Cathode Ray Oscilloscopes, Pt.3.

June 1996: BassBox CAD Loudspeaker Software Reviewed; Stereo Simulator (uses delay chip); Rope Light Chaser; Low Ohms Tester For Your DMM; Automatic Dog Feeder Update.

July 1996: Build A VGA Digital Oscilloscope, Pt.1; Remote Control Extender For VCRs; 2A SLA Battery Charger; 3-Band Parametric Equaliser; Single Channel 8-bit Data Logger.

August 1996: Introduction to IGBTs; Electronic Starter For Fluorescent Lamps; VGA Oscilloscope, Pt.2; Dolby Surround Decoder Module; Masthead Amplifier For TV & FM; Cathode Ray Oscilloscopes, Pt.4.

September 1996: VGA Oscilloscope, Pt.3; IR Stereo Headphone Link, Pt.1; High Quality PA Loudspeaker; 3-Band HF Amateur Radio Receiver; Cathode Ray Oscilloscopes, Pt.5.

October 1996: Send Video Signals Over Twisted Pair Cable; Power Control With A Light Dimmer; 600W DC-DC Converter For Car Hifi Systems, Pt.1; IR Stereo Headphone Link, Pt.2; Build A Multi-Media Sound System, Pt.1; Multi-Channel Radio Control Transmitter, Pt.8.

November 1996: Adding A Parallel Port To Your Computer; 8-Channel Stereo Mixer, Pt.1; Low-Cost Fluorescent Light Inverter; How To Repair Domestic Light Dimmers; Build A Multi-Media Sound System, Pt.2; 600W DC-DC Converter For Car Hifi Systems, Pt.2.

December 1996: Active Filter Cleans Up Your CW Reception; A Fast Clock For Railway Modellers; Laser Pistol & Electronic Target; Build A Sound Level Meter; 8-Channel Stereo Mixer, Pt.2; Car Burglar Alarm.

January 1997: How To Network Your PC; Control Panel For Multiple Smoke Alarms, Pt.1; Build A Pink Noise Source; Computer Controlled Dual Power Supply, Pt.1; Digi-Temp Monitors Eight Temperatures.

February 1997: Cathode Ray Oscilloscopes, Pt.6; PC-Controlled Moving Message Display; Computer Controlled Dual Power Supply, Pt.2; The Alert-A-Phone Loud Sounding Telephone Alarm; Build A Control Panel For Multiple Smoke Alarms, Pt.2.

March 1997: Driving A Computer By Remote Control; Plastic Power PA Amplifier (175W); Signalling & Lighting For Model Railways: Build A Jumbo LED Clock; Cathode Ray Oscilloscopes, Pt.7.

April 1997: Simple Timer With No ICs; Digital Voltmeter For Cars; Loudspeaker Protector For Stereo Amplifiers; Model Train Controller; A Look At Signal Tracing; Pt.1; Cathode Ray Oscilloscopes, Pt.8.

May 1997: Neon Tube Modulator For Light Systems; Traffic Lights For A Model Intersection; The Spacewriter – It Writes Messages In Thin Air; A Look At Signal Tracing; Pt.2; Cathode Ray Oscilloscopes, Pt.9.

June 1997: PC-Controlled Thermometer/Thermostat; Colour TV Pattern Generator, Pt.1; Build An Audio/RF Signal Tracer; High-Current Speed Controller For 12V/24V Motors; Manual Control Circuit For A Stepper Motor; Cathode Ray Oscilloscopes, Pt.10.

July 1997: Infrared Remote Volume Control; A Flexible Interface Card For PCs; Points Controller For Model Railways; Colour TV Pattern Generator, Pt.2; An In-Line Mixer For Radio Control Receivers.

August 1997: The Bass Barrel Subwoofer; 500 Watt Audio Power Amplifier Module; A TENs Unit For Pain Relief; Addressable PC Card For Stepper Motor Control; Remote Controlled Gates For Your Home.

September 1997: Multi-Spark Capacitor Discharge Ignition; 500W Audio Power Amplifier, Pt.2; A Video Security System For Your Home; PC Card For Controlling Two Stepper Motors; HiFi On A Budget.

October 1997: Build A 5-Digit Tachometer; Add Central Locking To Your Car; PC-Controlled 6-Channel Voltmeter; 500W Audio Power Amplifier, Pt.3; Customising The Windows 95 Start Menu.

November 1997: Heavy Duty 10A 240VAC Motor Speed Controller; Easy-To-Use Cable & Wiring Tester; Build A Musical Doorbell; Replacing Foam Speaker Surrounds; Understanding Electric Lighting Pt.1.

December 1997: Build A Speed Alarm For Your Car; Two-Axis Robot With Gripper; Loudness Control For Car Hifi Systems; Stepper Motor Driver With Onboard Buffer; PWM Speed Supply For Stepper Motor Cards; Understanding Electric Lighting Pt.2; Index To Volume 10.

January 1998: Build Your Own 4-Channel Lightshow, Pt.1 (runs off 12VDC or 120VAC); Command Control System For Model Railways, Pt.1; Pan Controller For CCD Cameras; Build A One Or Two-Lamp Flasher; Understanding Electric Lighting, Pt.3.

February 1998: Multi-Purpose Fast Battery Charger, Pt.1; Telephone Exchange Simulator For Testing; Command Control System For Model Railways, Pt.2; Build Your Own 4-Channel Lightshow, Pt.2; Understanding Electric Lighting, Pt.4.

April 1998: Automatic Garage Door Opener, Pt.1; 40V 8A Adjustable Power Supply, Pt.1; PIC-Controlled 0-30kHz Sinewave Generator; Build A Laser Light Show; Understanding Electric Lighting, Pt.5.

May 1998: Troubleshooting Your PC, Pt.1; Build A 3-LED Logic Probe; Automatic Garage Door Opener, Pt.2; Command Control For Model Railways, Pt.4; 40V 8A Adjustable Power Supply, Pt.2.

June 1998: Troubleshooting Your PC, Pt.2; Understanding Electric Lighting, Pt.7; Universal High Energy Ignition System; The Roadies' Friend Cable Tester; Stereophonic Stepper Motor Controller; Command Control For Model Railways, Pt.5.

July 1998: Troubleshooting Your PC, Pt.3 (Installing A Modern And Solving Problems); Build A Mini Theremin; 3-Watt Class-A Audio Amplifier Module; Simple Charger For 6V & 12V SLA Batteries; Automatic Semiconductor Analyser; Understanding Electric Lighting, Pt.8.

August 1998: Troubleshooting Your PC, Pt.4 (Adding Extra Memory); Build The Opus One Loudspeaker System; Battery I/O Card With Automatic Data Logging; Build A Beat Triggered Strobe; A 15-Watt Per Channel Class-A Stereo Amplifier.

September 1998: Troubleshooting Your PC, Pt.5 (Software Problems & DOS Games); A Bicycle Light Flasher; A Wax-Wax Pedal For Your Guitar; Build A Plasma Display Or Jacob's Ladder; Gear Change Indicator For Cars; Capacitor Discharge Ignition For Racing Bikes.

October 1998: Lab Quality AC Millivoltmeter, Pt.1; PC-Controlled Stress-O-Meter; Versatile Electronic Guitar Limiter; 12V Trickle Charger For Float Conditions; Adding An External Battery Pack To Your Flashgun.

November 1998: The Christmas Star (Microprocessor-Controlled Christmas Decoration); A Tuner Preamp For Hifi; A Poor Man's Phone, Pt.1; FM Transmitter For Musicians; Lab Quality AC Millivoltmeter, Pt.2; Setting Up A LAN Using TCP/IP; Understanding Electric Lighting, Pt.9; Improving AM Radio Reception, Pt.1.

December 1998: Protect Your Car With The Engine Immobiliser Mk.2; Thermocouple Adaptor For DMMs; A Regulated 12V DC Plugpack; Build Your Own Poker Machine; Improving AM Radio Reception, Pt.2; Mixer Module For F3B Glider Operations.

January 1999: High-Voltage Megohm Tester; Getting Started With BASIC Stamp; LED Bargraph Ammeter For Cars; Keypad Engine Immobiliser; Improving AM Radio Reception, Pt.3; Electric Lighting, Pt.10.

February 1999: Installing A Computer Network; Making Front Panels For Your Projects; Low Distortion Audio Signal Generator, Pt.1; Command Control Decoder For Model Railways, Pt.1; Capacitance Meter; Build A Remote Control Tester; Electric Lighting, Pt.11.

March 1999: Getting Started With Linux, Pt.1; Build A Digital Anemometer; Computer Interfaced Weather Station Logging; Simple DIY PIC Programmer; Easy-To-Build Audio Compressor; Low Distortion Audio Signal Generator, Pt.2; Electric Lighting, Pt.12.

April 1999: Getting Started With Linux, Pt.2; High-Power Electric Fence Controller; Bass Cube Subwoofer; Programmable Thermostat/Thermometer; Build An Infrared Sentry; Rev Limiter For Cars; Electric Lighting, Pt.13; Autopilots For Radio-Controlled Model Aircraft.

May 1999: The Line Dancer Robot; An X-Y Table With Stepper Motor Control, Pt.1; Three Electric Fence Testers; Heat Of LEDs; Build A Carbon Monoxide Alarm; Getting Started With Linux; Pt.3.

June 1999: FM Radio Tuner Card For PCs; X-Y Table With Stepper Motor Control, Pt.2; Programmable Ignition Timing Module For Cars, Pt.1; Hard Disk Drive Upgrades Without Reinstalling Software; What Is A Groundplane Antenna?; Getting Started With Linux; Pt.4.

July 1999: Build A Dog Silencer; 10µH to 19.999mH Inductance Meter; Build An Automotive Multi-Spark Discharge Ignition Timing Module For Cars, Pt.2; X-Y Table With Stepper Motor Control, Pt.3.

August 1999: Remote Modem Controller; Daytime Running Lights For Cars; Build A PC Monitor Checker; Switching Temperature Controller; X-Y2 Table With Stepper Motor Control, Pt.4; Electric Lighting, Pt.14.

September 1999: Automatic Addressing On TCP/IP Networks; Autonomouse The Robot, Pt.1; Voice Direct Speech Recognition Module; Digital Electrolytic Capacitance Meter; X-Y2 Table With Stepper Motor Control, Pt.5; Peltier-Powered Can Cooler.

October 1999: Sharing A Modem For Internet & Email Access (WinGate); Build The Railpower Model Train Controller, Pt.1; Semiconductor Curve Tracer; Autonomouse The Robot, Pt.2; X-Y2 Table With Stepper Motor Control, Pt.6; Introducing Home Theatre.

November 1999: Electric Lighting, Pt.15; Setting Up An Email Server; Speed Alarm For Cars, Pt.1; Multi-Colour LED Christmas Tree; Build An Intercom Station Expander; Foldback Loudspeaker System For Musicians; Railpower Model Train Controller, Pt.2.

December 1999: Internet Connection Sharing Using Hardware; Electric Lighting, Pt.16; Build A Solar Panel Regulator; The PC Powerhouse (gives fixed +12V, +9V, +6V & +5V rails); The Fortune Finder Metal Locator; Speed Alarm For Cars, Pt.2; Railpower Model Train Controller, Pt.3; Index To Volume 12.

January 2000: Spring Reverberation Module; An Audio-Video Test Generator; Build The Picman Programmable Robot; A Parallel Port Interface Card; Off-Hook Indicator For Telephone Lines.

February 2000: Multi-Sector Sprinkler Controller; A Digital Voltmeter For Your Car; An Ultrasonic Parking Radar; Build A Safety Switch Checker; Build A Sine/Square Wave Oscillator; Marantz SR-16 Home Theatre Receiver Reviewed; The "Hot Chip" Starter Kit Reviewed.

March 2000: Doing A Lazarus On An Old Computer; Ultra Low Distortion 100W Amplifier Module; Pt.1: Electronic Wind Vane With 16-LED Display; Glowbug Driver For Powered Models; The OzTrip Car Computer, Pt.1; Railroad Circuit Design & Simulation Package (Review).

April 2000: A Digital Tachometer For Your Car; RoomGuard – A Low-Cost Intruder Alarm; Build A Hot-wire Cutter; The OzTrip Car Computer, Pt.2; Build A Temperature Logger; Atmel's IQE 200 On-Circuit Emulator; How To Run A 3-Phase Induction Motor From 240VAC.

May 2000: Ultra-LD Stereo Amplifier, Pt.2; Build A LED Dice (With PIC Microcontroller); Low-Cost AT Keyboard Translator (Converts IBM Scan-Codes To ASCII); 50A Motor Speed Controller For Models: What's Inside A Furby.

June 2000: Automatic Rain Gauge With Digital Readout; Parallel Port VHF FM Receiver; L/I Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.1; Oil Compressor Modification For The Home.

July 2000: A Moving Message Display; Compact Fluorescent Lamp Driver; El-Cheapo Musicians' Lead Tester; L/I Powerhouse Switchmode Power Supply (1.23V to 40V) Pt.2; Say Bye-Bye To Your 12V Car Battery.

August 2000: Build A Thermrin For Really Eerie Sounds; Come In Spinner (writes messages in "thin-air"); Loudspeaker Protector & Fan Controller For The Stereo Amplifier; Projector Switch For 240VAC Lamps; Structured Cabling For Computer Networks.

September 2000: Build A Swimming Pool Alarm; An 8-Channel PC Relay Board; Fuel Mixture Display For Cars, Pt.1: Protoboards – The Easy Way Into Electronics, Pt.1; Quog The Solar Pig; Network Troubleshooting With Fluke's NetTool.

October 2000: Guitar Jammer For Practice & Jam Sessions; Boost Buster Breath Tester; A Wand-Mounted Inspection Camera; Installing A Free-Air Subwoofer In Your Car; Fuel Mixture Display For Cars, Pt.2; Protoboards – The Easy Way Into Electronics, Pt.2.

November 2000: Santa & Rudolf Chrissie Display; 2-Channel Guitar Preamplifier, Pt.1; Message Bank & Missed Call Alert Electronic Thermometer; Protoboards – The Easy Way Into Electronics, Pt.3.

December 2000: Home Networking For Shared Internet Access; Build A Bright-White LED Torch; 2-Channel Guitar Preamplifier, Pt.2 (Digital Reverb); Electronic LCD From The Parallel Port; Build A Home Safe; Protoboards – The Easy Way Into Electronics, Pt.4; Index To Vol.13.

January 2001: LP Reserrection – Transferring LPs & Tapes To CD; The LP Doctor – Clean Up Clicks & Pops, Pt.1; Arbitrary Waveform Generator; 2-Channel Guitar Preamplifier, Pt.3; PIC Programmer & TestBed; Wireless Networking.

February 2001: How To Observe Meteors Using Junked Gear; An Easy Way To Make PC Boards; L/I Polser Train Controller; Midi-Mate – A MIDI Interface For The Bass Buddy; Home Networking Using Groundplane Antenna; The LP Doctor – Clean Up Clicks & Pops, Pt.2.

March 2001: Driving Your Phone From A PC; Making Photo Resist PC Boards At Home; Big-Digit 12/24 Hour White-LED Torches To Build; A Servo Programmer & Checkerboard; Protoboards – The Easy Way Into Electronics, Pt.5; More MIDI – A Simple MIDI Expansion Box.

April 2001: A GPS Module For Your PC; Dr Video – An Easy-To-Build Video Stabiliser; A Tremolo Unit For Musicians; Miniature FM Stereo Transmitter; Intelligent Nicad Battery Charger; Computer Tips – Tweaking Internet Connection Sharing.

May 2001: Powerful 12V Mini Stereo Amplifier; Microcontroller-Based 4-Digit Counter Module; Big-Digit 12/24 Hour White-LED Torches To Build; A Servo With Lots Of Grunt; PowerPak – A Multi-Voltage Power Supply; Using A Linux To Share An Internet Connection, Pt.1; Computer Tips – Tweaking Windows With TweakUI.

June 2001: Fast Universal Battery Charger, Pt.1; Phonome – Call, Listen In & Switch Devices On & Off; L/I Snooper – A Low-Cost Automatic Camera Switcher; Build a PC Games Port Tester; Using Linux To Share An Internet Connection, Pt.2; A PC To Die For – And You Can Build It Yourself; New Generation Plotless Aircraft.

PLEASE NOTE: November 1987 to March 1989, June 1989, August 1989, December 1989, May 1990, February 1991, June 1991, August 1991, February 1992, July 1992, September 1992, November 1992, December 1992, May 1993, February 1996 and March 1998 are now sold out. All other issues are presently in stock. For readers wanting articles from sold-out issues, we can supply photostat copies (or tear sheets) at $7.70 per article (includes p&p). When supplying photostat articles or back copies, we automatically supply any relevant notes & errata at no extra charge. A complete index to all articles published to date is available on floppy disk for $11 including p&p, or can be downloaded free from our web site: www.siliconchip.com.au

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Engine immobiliser for diesels

Are the various kits about based on your December 1998 Engine Immobiliser Mk2 (ie, Jaycar KC-5255) suitable for diesel engines? It appears to me that this circuit only works with coil-equipped cars. If it won't be suitable, is there an alternative? (W. M., via email).

● As it stands, the immobiliser is set to kill the spark from the ignition coil. To make it work on a diesel you would have to make it kill the signal to the injectors or turn off the fuel pump to the fuel rail. Probably the easiest method would be to turn off the fuel pump using a suitably rated relay driven by the output transistor Q1.

Low-powered surround sound system wanted

Can you suggest a project for a reasonably low-powered 20-50W/channel amplifier for a surround sound system. (J. E., via email).

● Have a look at the 20W amp module in the December 1993 issue and/or the 40W/50W module in the March 1994 issue; also the twin 50W module in the February 1995 issue. All modules are presently available from Altronics. We can supply the back issues for $7.70 each, including postage.

Fridge interference to audio system

I have been having trouble with loud 'pops' in my stereo system when the fridge switches off. The system includes the "Electronics Australia" Pro Series One power amplifier and Pro Series Two preamplifier and a High Definition Audio device (ex Jaycar) installed between preamp output and power amp input.

I have installed some varistors on the 240VAC input side of the power amplifier and poly switches on the output side of the amplifier. The fridge has an electromechanical timer installed to control the compressor & defrost cycle (I think).

These 'pops' don't always occur but are definitely coming from the fridge through the mains and into my stereo amplifier. Can I damp the contacts of the timer in the fridge with a series RC network to remove the spike that I assume occurs when they go open circuit? (C. L., via email).

● Connecting your audio gear via a mains filter might be a cure but we suspect that the amplifier or its preamp are picking up interference radiated from the mains wiring each time the fridge clicks off. Whether or not a 'pop' occurs depends on when in each cycle of the 240VAC mains waveform the fridge actually switches off. There is probably little point in trying to suppress interference at the switch – we expect it already has these components.

You will have to do some detective work to figure out how the interference is getting into your system. For example, is it getting in via the speaker leads? You can test this by disconnecting the speakers and listening to your system via the headphones.

Is it getting in via the preamp? Disconnect the preamp and see if clicks are still picked up. Then you might find that you can cure the problem by winding the offending leads through ferrite toroids. In the worst case though, it may be necessary to modify the input and output stages of the amp and preamp to completely stop the problem.

Some designers exacerbate these problems by designing their circuits with excessive bandwidth.

Trouble with quiescent current setting

I've been testing one of the output modules for the Ultra-LD 100W Amplifier (described in the March, May & August 2000 issues of SILICON CHIP) and I am having trouble with the quiescent current. When I measure the voltage across the 220Ω 5W resistor with VR1 fully anticlockwise, the lowest voltage I get is 0.68V. If I leave the DMM attached for a few minutes, the voltage rises to 9.3V then sort of cycles between that and 8.3V.

Is this because I haven't attached the heatsink yet? There are great differences in the temperatures of each pair of the MJL devices. Out of each pair, one is too hot to touch, the other is lukewarm or cold.

The voltages across the 1.5Ω resistors stablilise at 13-14mV, not 7.5mV.

White LED torch modifications

I constructed the White LED Torch (described December 2000) from a Dick Smith Electronics kit. It works brilliantly. I have two questions on it. Is it possible to run the LED at 20mA+ from a 1.2V rechargeable cell with minor changes to the circuit? This would make the unit more useful on long trips away from services. Can it run, with modification, from a 3V source, allowing incorporation into a combined radio/torch setup? (H. J., via email).

● The White LED Torch can be operated from 1.2V by shorting out resistor R1. This will increase the current drive to the LED. Essentially, the current is limited by the DC resistance of inductor L1 since this determines the saturation current. Winding your own using the Xenon tube transformer former will enable you to increase the LED current when using a 1.2V supply. You would need to use 250 turns of 0.25mm enamelled copper wire (rather than the 0.16mm wire specified) on the bare former.

You could run the torch from 3V but resistor R1 should then be increased to 4.7Ω.

Is this all because I don't have the heatsink attached? (D. M., via email).

● You must have the heatsinks attached before you can make any sense of the quiescent current adjustment. What happens is that Q10, the Vbe multiplier, monitors the temperature of the output transistors and adjusts the bias accordingly. Q10 can't work properly if the heatsink is not fitted.

Hands-free phone amplifier wanted

I find that I am being placed "on hold" when I phone a large number of organisations. Why not offer a small amplifier to rest your phone ear piece on to hear when the called number is back to you or better still, a complete hands-free amplifier and microphone to listen and talk while your hand phone rests on it? It could be mains or battery-powered and activated when the phone hand piece is placed on the unit and shut off when the phone is removed. (N. S., via email).

● Have you seen our Hands-Free Speakerphone design presented in the September 1988 issue? This could fit your needs. We can supply a photostat copy of the article for $7.70 including postage & GST.

Solar power for big digit clock

I would like to power the Big Digit Clock (described in March 2001) from a solar power supply. I need to know the current and consumption of the clock in order to make the power supply. Can you help me? Is there anything else about the clock that I need to change? (M. S., via email).

● The clock can be run using solar cells and a battery. The circuit will draw a maximum of 400mA or 4.8W at 12V. In low light, the display will draw less current, dropping to around 100mA (1.2W) at night. So on average, the clock will draw about 300mA (3.6W) depending on the length of daylight hours.

A-V transmitter has poor range

A while ago I bought an Audio/Video Transmitter (described in July 1999) from Jaycar. I have finally got around to building it. I have two problems though, and hope you can help. After building the kit, I tested it using my DVD player. It works fine if I don't take it any more than about 2-3 metres away! Any more than this and I start to lose the signal and get poor reception. I have tried adjusting the trimpots and still get the same result.

I have also tried to connect up a CCD camera using the power output and video input but get no results. I purchased the camera from Dick Smith Electronics and testing shows that the power is getting through and there is some sort of signal. Why won't it work? (J. R., via email).

● Check that the 3-terminal regulators have not been transposed. We referred to this in Errata published in February 2001. The 5V regulator (7805) should be nearest to IC2 and the 12V regulator (7812) closest to diode D2. Check that you have these correct. There should be 12V available for the video camera.

The transmission range does seem to be very poor. This suggests that one of the amplifiers, IC1 or IC2, is not working. This could be because one is connected incorrectly, an open-circuit connection to one of the pins or there is a short. Also check that the connection passing into the RCA socket for the modulator output (see the Jaycar notes on connecting the wire directly rather than using the plug) is not shorting to the case of the modulator.

Plug the camera directly into your TV or VCR to check if it is working correctly, before trying to get it operational on the transmitter.

Using Dr Video with NTSC signals

Is the Dr Video stabiliser published in the April 2001 issue only applicable to PAL signals or is it universal? Specifically, can I use it on my DVD player when outputting NSTC signals? (S. B, Wollongong, NSW).

● The timing for NTSC signals is close enough to PAL to allow the circuit to work fairly well. However, some of

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PIC NiMH charger wanted

You recently published a NiCad battery charger for power tools (April 2001). How about a similar project for NiMH batteries? The only difference I'd need is 12VDC input so I could use it in the car. I'd be using it to charge four AAs for my digicam while on holiday. (A. G., via email).

● There should be no reason to change the design at all apart from a change to the 3.3kΩ sensing resistor to cope with the lower voltage from your battery pack. However, we are not certain whether the PIC's code has the resolution to cope with the required dV/dt end-of-charge detection.

NiMH cells have a very similar charge profile to NiCads but they peak at around 1.8V. You need to be aware also of the C value and note that NiMH cells like to be charged slightly below 1C (about 90%). If the batteries are around 1450mAH then 1Ω should be OK for the current limiting resistor.

the latest NTSC releases on DVD have an 'improved' version of Macrovision which isn't easy to remove. So the results on these DVDs may be disappointing.

Where to get BASIC

● We occasionally get queries about where to get BASIC for use with various past projects. As some readers may be aware, GWBASIC/QBASIC interpreters were supplied free until DOS version 6. The original IBM PC even had a ROM-based interpreter (BASICA).

We've had a good look at what's available and can thoroughly recommend FirstBASIC, available as shareware ($US25 to register) from http://www.powerbasic.com

You'll find it listed on their downloads page.

FM SCA decoder/ multiplexer

I was wondering if you have ever published a design for a circuit to decode the SCA (subcarrier auxiliary) channels that are transmitted by some of the FM broadcasters. I am not really interested in using it for this purpose, but I want to build a multiplex system designed around the same principle.

I have several wideband (100kHz) radio links that I want to feed to up to six narrow-band (0 to 3.5kHz, phone quality) audio channels. I thought that by modulating subcarriers, as they do with SCA, I could achieve the results that I want. I planned to use subcarriers at, 25kHz, 35kHz, 45kHz, 55kHz and so on. (P. D., via email).

● We published an ACS Adaptor (same thing as SCA) in the January 1988 issue. We can supply a photostat copy of the article for $7.70 including postage.

Charging circuit for a strobe lamp

I am trying to solve a puzzle, on how to charge a 680µF capacitor quickly, up to 320-340V DC, suitable for a high-speed disco strobe. The existing circuit is an AC-to-DC converter, which then steps it up to 500V DC using a Mosfet and an inductor. It's way too slow and inefficient.

I know that by using a high-voltage diode and some sort of current limiting device, you can charge a capacitor to 320V from the 240VAC mains supply. I have experimented with various devices to achieve this, from a fluorescent light ballast to a light bulb to resistors and even winding my own inductor.

I need this circuit to repeatedly charge this capacitor quickly, providing the 320V DC needed to fire the large Xenon bulb of the strobe. The trigger circuit etc is the easy part which I can do myself. (J. W., via email).

● How fast do you want the strobe to be? We published a beat-triggered strobe in the August 1998 issue which would run at up to 20 flashes per second. Anything faster tends to be perceived as continuous light so there is not much point.

Our design used two 470Ω 5W resistors in series with a bridge rectifier running directly from 240VAC. It is quite fast enough and if you use higher charge currents and faster flash rates the limiting factor becomes the ripple current ratings on the discharge capacitor. We can supply the August 1998 issue for $7.70 including postage.

Notes and Errata

Parallel Port PIC Programmer and Checkerboard, March 2001: the circuit diagram on page 64 indicates that IC1 is an inverter. In fact, IC1 is a 7407 hex buffer with open-collector outputs. These buffers do not invert from input to output.

Some kits for this project have been supplied with a female D socket and "gender changer". This will not work. The specified male D socket must be used. **SC**

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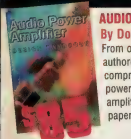

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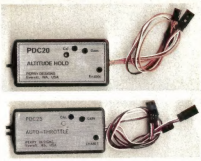

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